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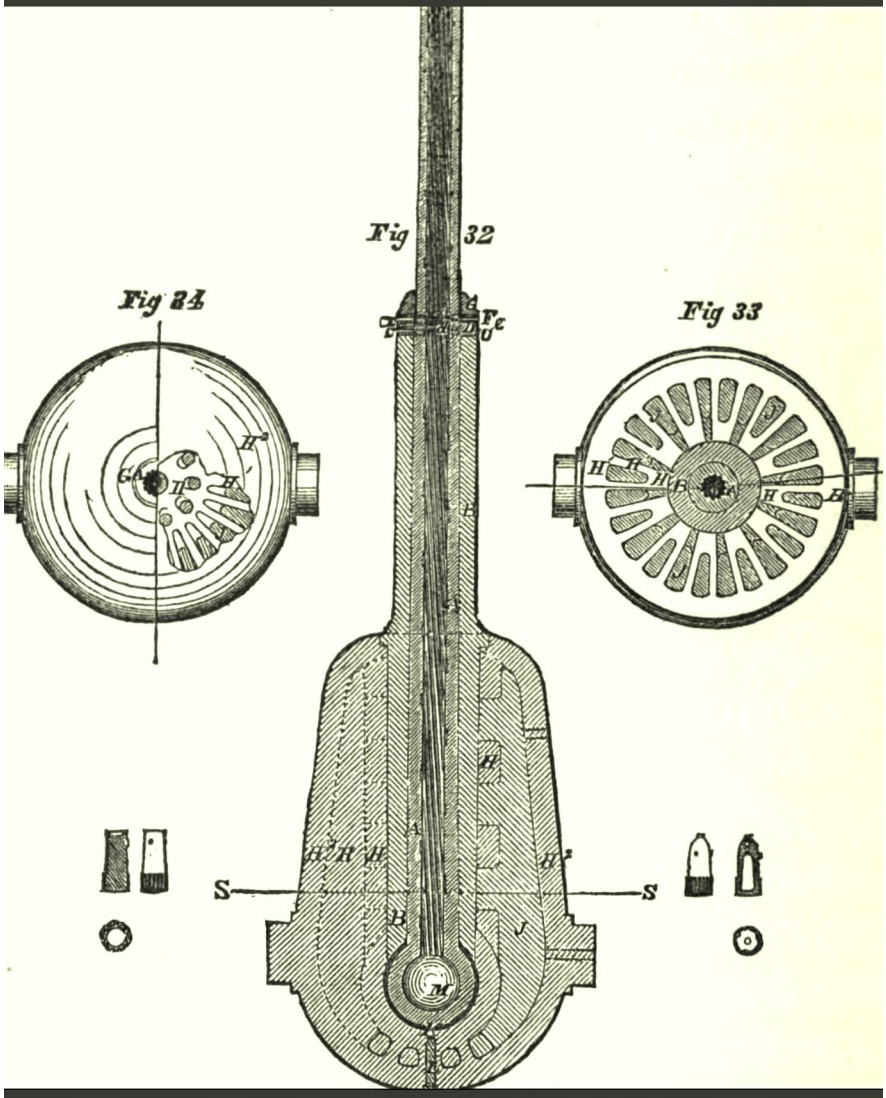

Inefficiency of heavy ordnance in this country and everywhere

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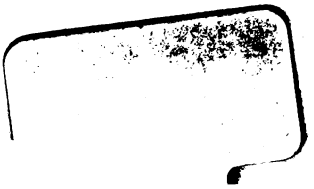

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Title:

Ordnance

Pamphlets:

1. Wiard, W.— Inefficiency of Ordnance and Elsewhere.

2. Same.—. Great Guns, th of their failure.

3. Same.- On a Means of the Manufacturers of Materi

4. Same.- Memorial - to Co

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INEFFICIENCY

OF

HEAVY ORDNANCE

IN THIS COUNTRY

AND

EVERYWHERE,

AND

About Parrott and other Hooped Guns.

SECOND EDITION—REVISED.

By NORMAN WIARD.

WASHINGTON:
H. POLKINHORN & SON, PRINTERS.
1865.

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War 4298.65

HARVARD COLLEGE

1865. May 24
Gift of
Hon. Chas. Sumner,
(A.C. 1830.)

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PREFACE.

A board of naval officers are now in session in this city to enquire (it is supposed) why so fearful a destruction of life by bursting of Parrott guns occurred in the fleet of Admiral Porter, during the late bombardment of Fort Fisher. I came to Washington with diagrams and drawings, costing me four months of labor and a carefully studied argument containing information on this subject, hoping to be permitted to appear before that board and communicate my views, which, however, was refused, although I made earnest application to the Chief of the Bureau of Ordnance, and to the Assistant Secretary of the Navy. It might be considered, that this board had been called together prematurely, if it were known that no particular information about the six guns that burst on this occasion has been received, the inspector's numbers of the guns, how many rounds were fired on this occasion, or how many previously. How rapidly they were fired, at what elevation, with what charges, and what was the direction of the fracture, is not known.

But the Ordnance Departments have had plenty of experience with these guns. They know where to find examples of them burst, exhibiting every conceivable kind and direction of fracture during every kind of service. They have in their possession photographs of so large a number of them burst on Morris Island, under General Gilmore,* that knowing so much about them, they will find it difficult to excuse themselves to an indignant people, when General Gilmore's book comes to be published and the facts known to outsiders, for having exposed our gallant tars to be murdered by them, or for having destroyed the confidence of our sailors so far that they will hesitate at the next emergency. The Chief of Ordnance,† and the Assistant Secretary of the Navy, each requested me to communicate my views in writing to be laid before the board. This I was unwilling to do in any manner by which it would be possible to file it away in a pigeon hole. I had not time to have my drawings engraved to be able to furnish copies with a paper, and I could not afford to give to the department the originals costing me so much labor.

Immediately after the refusal of my application to go before the board, it occurred to me that this board was convened to whitewash the Parrott gun, rather than to learn why they burst or failed. I then decided to print this pamphlet. It has been hastily prepared, and being without diagrams or drawings to illustrate it, will not be as convincing as I could wish, but it communicates some facts and some theories. Perhaps it will lead some persons to think I am not amiable. I hope that will not be the strongest impression.

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* The operations of Gen. Gilmore in Charleston harbor were conducted in 1863, consequently the failure of the Parrott guns has been known since that time.

† I shall regret it much if it is considered that I have made any personal allusions in this paper. I object generally to the system that obtains in the management of our Ordnance Departments, under which the designing and manufacture of guns is confined to a few persons, jealous of the interference of all others. And I object to the system or want of a system upon which guns are made. I am in a hurry—I wish to see our ordnance improved so that it will excel that of all other nations without delay. I make my charges against a whole class, and thus I feel confident I include the individuals who are to blame for such long continued failure to produce effective heavy ordnance, and who have had the United States Treasury for working capital. I believe my own studies and experiments, without official encouragement, have produced more valuable results.

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NOTICE.

For further and more minute information on the subject of the following paper, I would refer to Holley's Work on Ordnance and Iron-Clad Defences, (a work published by Van Nostrand, New York, to be obtained in Washington of Franck Taylor, Penn. Avenue,) in which the construction of most guns in any service is illustrated and described;

To the Report of Gen Gilmore, for the particulars of the guns burst on Morris Island, to be procured at the same place, as soon as published;*

For a corroboration of the statement, (page 13,) that the strongest metal does not make the strongest gun, see Rodman's book, pages 137 and 138. This is a strong evidence of the correctness of the Wiard theory;

To a pamphlet by Norman Wiard, published in the spring of 1863, entitled "Great Guns, &c.," which can be obtained of the author, (without cost) on application: in which, for a record of failures, see pages 11 to 19 inclusive;

An estimate of pressure of powder, from pages 26 to 33 inclusive;

Rodman's instrument for measuring pressures, from pages 36 to 40 inclusive;

A plain, practical statement "Why Guns Burst," pages 44 to 66 inclusive;

And "Diagrams of Burst Guns, by Norman Wiard," not published, but to be seen by any one by calling upon the author.

WASHINGTON, 10*th Jan.*, 1865.

*I have a copy of advance sheets, which can be examined by any one calling upon me.

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Inefficiency of Heavy Ordnance.

BURSTING OF GUNS.

It is a terrific disaster that results from the bursting of large guns on board ships, or in crowded casements; besides killing or wounding gunners, and wasting property, the guns themselves, carriages, implements, and the ship, or works near, it demoralizes the men of the immediate force, affects the morale of the whole service, and detracts from the military prestige of the nation.

PARROTT GUNS.

We have foolishly boasted about Parrott guns, and now must swallow the "bitter pill" by condemning them; which, however, even now, we must do with reluctance; for we have no other system of established reputation* to take their place, although we might have had. The departments having charge of the fabrication of our guns are not more to blame for their errors of commission than of omission, for during four years of active war they should have learned the exact cause of failure, and the proper remedy. We should actually have what it has been boasted we had, viz: guns of absolute endurance when fired rapidly, giving

*Whatever may be the defects of the Parrott system of rifled ordnance, no other has yet been produced which commends itself so strongly to the service, and until another and better one is devised, and subjected to the same ordeal, the bureau will continue to place its guns in batteries of ships as important auxiliaries to the smooth bore pivots.—*Report Chief of Ordnance.*

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precision, and high velocity to the shot for penetration, and long range.

If we have not learned how to make reliable guns through this exclusive system, employing so many of our officers, educated at the public expense, and at so much cost of book publishing, foundry experiments, and rejected guns, or guns that should be rejected, and at so much cost for loss of efficiency in ships of war, forts, navy yards, arsenals, plant, ordnance stores, powder, life and limb,* is it not time we should enquire how to improve our Ordnance Departments and guns at the same time?

Is it forgotten that we are now engaged in war, and are we not to look ahead at the possible complications of the future?

JEALOUSIES.

If, during the last four years of war, improvements in ordnance have been presented to the departments, they have received no official recognition. They interfered with the patented plans of officers always in intimate relations or in prominent positions in the Ordnance Departments. The Masonry of the regular service has surrounded the approaches, and always provided the necessary barriers and outworks to keep innovators at a distance, exhibiting in this, if in no other way, the advantage of a small force standing shoulder to shoulder, and also their skill in defensive strategy.

The experimental battery of the Navy near the Navy Yard, Washington, is hedged about with as profound a

*It will be remembered that the only casualties among the Union fleet during the recent bombardment of Fort Fisher, were the forty-five persons killed or wounded by the bursting of Parrott rifled cannon—so named after the maker, of the West Point Foundry, New York. Admiral Porter, after enumerating the killed and wounded on the different vessels, on board of each one of which a cannon burst, said:

"I think the bursting of the guns much disconcerted the crews of the vessels where the accidents happened, and gave one and all a different distrust of the 100-pounder Parrotts; and, as subsequent events proved, they were unfit for service, and calculated to kill more of our men than those of the enemy."—*Intelligencer.*

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secrecy as the ancient *Holy Vehme* in Germany and Italy. Occasionally the demolition of a target made by some outside inventor is made public, as if only to deter others from like efforts, but usually a guard keeps all persons at a distance.

Another great bar to progress in our service, is the inordinate jealousy existing between the Ordnance Departments of the two branches of the service—the Army and the Navy—only exceeded by the jealousy of outside inovators.*

The ordnance service of France and England in time of peace are not more antagonistic to each other than the two branches of our service, the Army and Navy, at all times.

The dimensions of large guns are given to the founder in the most minute divisions of inches, hundredths and thousandths, and any deviation from these dimensions within very minute limits, rejects the gun, even when the models of the two branches of the service, intended for the same charges vary to the extent of many whole inches; and the nicest instruments and most painstaking inspectors spend their time and the money of the Government in the determination of these hair-splitting distinctions.

The Washington Navy Yard had lately placed on skids, side by side, a number of Army and Navy guns, on each of which was an inscription showing the endurance of the Navy guns to a large number of rounds, and the statement that it was made of the same quality of iron as the Army gun, of same calibre, beside it, which had burst after an insignificant endurance. As a counterpart to which, Army Ordnance officers published elaborate and costly books to show that the Navy system of solid cast guns was inferior to the hollow cast or Army system for heavy ordnance. When General Gilmore determined to publish the result obtained on Morris Island with Parrott guns, in which a number of them

* See correspondence between General Gilmore and Admiral Dahlgren, Gilmore's book, appendix H.

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burst, the Navy Ordnance Department, always exercising paternal care over Parrott guns, made an effort to have it suppressed, in which they failed. Then the Chief of Ordnance, to balance that account in his report,* pitched into the Springfield musket, the pet of the Army Ordnance Department, by publishing all about twenty or thirty thousand arms of that kind picked up on the field of Gettysburg, each having from one to ten charges in the bore,—cited to show the necessity of a breech loading gun for infantry. If a breech loader is best, then the Army Ordnance should have found it out long since, before so large a stock of arms accrued on hand. If the Springfield musket is best, then the Navy Bureau should not have made this disclosure prematurely.

UNIFORMITY OF CALIBRE.

There is a remarkable want of uniformity of calibres between the Army and Navy Ordnance, for same weight of projectile, and when by chance each Department have guns of same calibre, the only example of which is the 8 and 15-inch calibres, the chambers and models are different. The Army have 8, 10 and 15-inch calibres. The Navy have 8,

*The official report of the examination of the arms collected upon the battle-field of Gettysburg, states that "of the whole number received (27,574) we found at least 24,000 of these loaded; about one-half of these contained two loads each, one-fourth from three to ten loads each, and the balance one load each. In many of these guns from two to six balls have been found, with only one charge of powder. In some the balls have been found at the bottom of the bore with the charge of powder on top of the ball. In some, as many as six paper regulation calibre, 58 cartridges have been found, the cartridges having been put in the guns without being torn or broken. Twenty-three loads were found in one Springfield rifle-musket, each load in regular order. Twenty-two balls and sixty-two buckshot, with a corresponding quantity of powder all mixed up together, were found in one percussion smooth-bore musket. In many of the smooth-bore guns, model of 1842, of rebel make, we have found a wad of loose paper between the powder and ball, and another wad of the same kind on top of the ball, the ball having been put into the gun naked. About six thousand of the arms were found loaded with Johnson & Dow's cartridges; many of these cartridges were about half way down in the barrels of the guns, and in many cases the ball end of the cartridge had been put into the gun first. These cartridges were found mostly in the Enfield rifle-musket."—*Report of the Chief of Bureau of Ordnance, Navy Department.*

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9, 11, 13 and 15-inch calibres, as if the Navy choose odd numbers for luck. The 12-pounder rifle in the Navy has a calibre of three four-tenths inches: the Army now three-inch and lately three inches sixty-seven hundredths; consequently Army and Navy ammunition or guns can never interchange for an emergency. Wherever the calibre is uniform the chamber and model is different. The Army fire three proof rounds, one and a half charges of powder each, for proof of guns; the Navy ten service charges.

TWENTY-INCH GUNS.

The War Department cause a twenty-inch gun to be made at Pittsburg and pay for the gun and all the machinery and apparatus necessary to make it, at the semi-official Army Ordnance Foundry. It is unusual for the War Department to make such investments and take such risks, and it would not be done with any essentially private contractor. Beside, neither the War or Navy Department would accept even a smaller first gun of a new model from a private contractor, without an extreme proof of from five hundred to one thousand rounds; but in this case, where the doubt of success must have been greater than in any gun ever made in the world, the gun is put into service without the extreme proof. The Navy, without waiting for the ordinary proof even of this great gun, order another to be cast of the same calibre, and about the same weight, but of a different model peculiar to the Navy. Perhaps they have not and never will have a ship upon which it can be mounted, and have simply undertaken this costly experiment to show themselves capable of as grand a folly as their competitors in the War Department Ordnance service.

A MERE OPINION.

I will venture the assertion, that if the twenty-inch gun mounted at the Narrows, New York, is trained upon a steam-

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ship, when it is two miles below, coming up the harbor at a speed of twelve knots per hour, that it cannot be loaded to fire at the ship a second time until it is two miles or more above it; in other words, a moderately fast ship can sail four miles or more while the gun is being loaded;* further, without attempting to load the gun at all, men enough cannot be got about it to train it around so as to keep it pointed at a fast steamer.

And if it ever is attempted to point it at a ship that is moving erratically on in a zig-zag direction, it will be found so ponderous that correct pointing cannot be attained, and the chances of a hit will be less than one in a million. Such guns may have some moral effect, but they will never have any other.

The question of how to make the best gun is of such great importance, however, that the follies or wrongs in the expenditures of public money or the idiosyncracies of individuals sink into insignificance, and to mention them in the same paper in which it is proposed to enquire why guns fail and how they should be constructed, must be justified by the reflection that we are only inspired to battle for right by having our indignation incited by the recollection of wrong.

WHY GUNS BURST.

About two years since I published in the New York *Tribune* an article entitled "Why Guns Burst," and later a pamphlet on "Great Guns: the Cause of their Failure, &c." In both of these articles, I endeavored to show, that their fail-

*I have fired a field gun eight times in one minute without bursting it. Musket barrels and field guns do not burst, because they are heated through. So also we can light a gas-burner within a thin glass globe without bursting it, when a thick one would fly into fragments. The 20-inch gun could not be fired twenty rounds rapidly without bursting. If it was properly constructed so that it could be fired rapidly, and proper appliances (machinery) to enable gunners to discharge it twice in one minute, which I believe possible, it would be equal to forty guns of the capacity of this one, and would save the exposure of a long face of earth or other works to enemy's shot, and thirty-nine guns, carriages, &c.

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ure was due principally to the unequal expansion of the metal of the gun by the heat of the powder when being fired, and consequently rifle guns were more likely to burst than smooth bores, because the surface of the bore was longer exposed to the high temperature, as it takes a longer time to eject the shot from a rifle than a smooth bore gun, and the pressure of the gases and per consequence their temperature is higher; also, that guns were more liable to burst when fired at high elevations for the same reason. When fired rapidly because more heat is communicated to the surface of the bore in a given time. When fired in cold weather, because the gun is then most contracted on the out side. A remarkable confirmation of these views has lately occurred in the bursting of six large Parrott guns* during the bombardment of Fort Fisher, at which time a large number of heavy guns were fired more rapidly than at any time before during the war.

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* Mr. Parrott, in a communication to General Gilmore, says: "In the small number of accidents which have happened with my guns in the naval service, not one has occurred from the blowing out of the breech." Mr. Parrott has now some examples of this kind.

He also asks, "Can a theory unfavorable to the guns be reconciled with so many discordant facts, or apply to one branch of the service only?"

Let us see what are the discordant facts. First, The army guns have, up to this time, burst more frequently than navy guns. This is not longer discordant, for the navy have now burst a number. 2d. One gun has endured 4,606 rounds when it burst; another burst at the 36th round. The gun that exhibited such great endurance was fired slowly—once in fifteen minutes—and was a small gun; the other was fired more rapidly and burst. 3d. The direction of fracture does not follow any general law; it is *very* discordant in this. The breech has blown out; the gun has burst in front of the band and sometimes under the band, breaking the band also. The accident to the Whitworth guns, shown in General Gilmore's report, is an indication of the cause of the bursting of those Parrotts that had their breech blown out, viz: *by the increase of the length of the inner metal by the heat of firing:* in these Whitworth guns the inner tube was expanded and projects one inch. The same heating that will lengthen the inner metal enlarges its diameter also: hence the longitudinal fracture. (See Wiard's pamphlet, "Great Guns," pages 44 to 65.) For a theory of the cause of Parrott guns *bursting at the muzzle*, see "Great Guns," pages 34 and 35. General Gilmore says: "Most of the premature explosions of shells took place in front of the gun—of eighty such explosions from the 30-pounder, *not one took place in the bore of the gun.* I am aware Mr. Parrott assigns this as the cause of the rapid destruction of his rifles."

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In this action all the ships were anchored in position and each gun was fired continuously and rapidly.

Reports from rebel papers state that two Brooke guns burst in Fort Fisher during the same bombardment. The Brooke gun is like the Parrott, and the casualties in the fort were not greater than in our fleet from the bursting of the guns. At Fort Sumter, under General Anderson, the only casualties that occurred to either side, after a furious and terrific bombardment, were caused by the bursting of a gun when firing a salute after the battle was over.

At Port Royal, where the guns did not burst, the ships were sailing round in a circle, only delivering a broadside as each passed the works of the enemy on shore; and during the long interval between the shots the heat was uniformly distributed throughout the gun, expanding it in all parts equally.

Those who have watched the progress of improvements in ordnance carefully in this country and in Europe, could scarcely have failed to notice three facts connected with the subject, viz: 1st, That the confidence in the success of every system of heavy ordnance adopted in any service has been based upon experiments upon smaller guns, only to disappoint the hopes of the projectors when the same system came to be applied to heavier guns, as witness the Armstrong, Whitworth and Parrott systems. 2d, That a most remarkable uncertainty of endurance has been noticed in guns of large sizes when made in pairs of the same size, model and plan, and as near as possible of the same quality of material: the endurance would be different and guns would burst with small charges after having endured large charges; and 3d, that the strongest material (as steel in place of cast iron, &c.) in large guns of the same size and model does not make the strongest gun.*

* See "Great Guns," pages 16 and 17, quotation from Rodman's book.

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TWO SYSTEMS.

Guns, it may be said, have been constructed upon two systems, or one distinct system and one want of system—the first embodying initial tension, in which an inner tube has one or more bands shrunk upon it. (Parrott guns have one band, Armstrong a number of bands one upon another.) Of this kind of gun with initial tension, Treadwell, Blakely, Armstrong, Whitworth and Parrott guns are examples. Rodman applies initial tension, but attained in a different manner; and second, guns cast solid, as by Dahlgren.

A FAMILIAR EXAMPLE.

Inexpert persons who have witnessed the blasting of rock by powder, have, perhaps, been struck with wonder at what appeared to be the immense power developed from a small charge of powder, acting against the small surface of the bore in the rock; it seems wonderful that it would create such extensive area of fracture, and lift such enormous weight. It acts in this manner, and the whole operation can be best comprehended by dividing it into succeeding operations, or dividing the operations into historical periods, as Professor Treadwell does the time occupied by combustion of a grain of powder. The rock is somewhat compressible, and of brittle texture. The pressure of powder enlarges the diameter of the hole by compressing the material immediately surrounding it. Then first suppose the bore two inches in diameter to be so enlarged as to start two cracks on opposite sides to a depth of two inches, the gases of powder enter these cracks, acting then upon a surface six inches wide. If the pressure in the bore, two inches in diameter, was before sufficient to induce cracks two inches wide each side, when the pressure acts upon six inches it will be sufficient to continue the cracks six inches in addition on each side—making eighteen inches width of

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surface upon which the pressure acts to continue the fracture further.

PROFESSOR TREADWELL.

Thus, it will be seen, that increasing the thickness of the wall of a gun does not add to its strength, if a crack is initiated. If powder had no effect upon the walls of the gun but pressure, it is evident that by shrinking band upon band, each with a proper degree of tension, a cylinder might be made in which the fractures would have to occur throughout the whole thickness at the same instant. Constructed in this manner, *i. e.*, with initial tension, no cracks could occur inside, and no increased area of surface for pressure to act upon. Or, in other words, it is possible so to construct a cylinder that it will resist almost any required degree of pressure by increasing the thickness of the walls with initial tension. This has been nicely illustrated by Professor Treadwell, and the necessity for applying this mode of construction, as follows:

"If we make a cylinder of forty-one concentric hoops of equal thickness, disposed one within another, and exactly fitting, so that the particles of each hoop shall be in equilibrium with each other, the diameter of the largest being five times that of the smallest, then the force of each, beginning with the innermost, to resist distension, will be represented by the following numbers:

1,000	250	111	62
836	225	104	58
694	207	98	56
591	189	92	54
510	175	87	51
444	160	82	49
391	148	77	47
346	135	73	43
309	128	69	45
277	119	65	41
			40

If this series of bands were shrunk upon one another with proper strain or pressure, a pressure acting to enlarge the

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bore would be resisted by the outside band equally with the inner one, and the cylinder would be in a state of initial tension. In this manner the Parrott, Armstrong, Whitworth, Blakely, Treadwell and Brooke guns are in effect made, and, like the Rodman gun, are in the best state to resist the pressure of the powder.

If we purpose to use a cylinder prepared with initial tension to withstand pressure *as a gun*, another element comes into the calculation, namely, the heat evolved.

Metals expand by being heated with the same force with which they would resist compression. The metal of a gun prepared with initial tension has already been compressed nearly as much as is possible within the limit of the tensile strength of the bands, and exerts a force as it expands sufficient to break the reinforce already strained, and in this is the *rub*. If we put the gun in the best state to resist the pressure of the powder, it is in the worst state to resist the unequal expansion from the heat of firing. Thus it is seen that pressure is not the only effect of the powder.

DAHLGREN.

If a gun were made without initial tension, when pressure was applied sufficient to start a crack outwards through the strongest of these rings, the pressure acting upon the increased area of surface would continue the fracture indefinitely. The Dahlgren gun is cast solid, and has initial tension in opposite direction to the Parrott guns; that is, the strain in the casting has a tendency, when the gun is new, to assist the pressure of powder to enlarge the bore, which is again counteracted by the heating inside. The centre of the cast block from which the gun is made is quite porous. By slow cooling of the large mass, this porosity is reduced as much as possible in a large block cast in that manner; the most spongy part is then bored out, in the gun of eleven-inch calibre. After a few rounds in this gun the

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bore becomes enlarged by a slow process, due to the united efforts of both the heating and pressure, until the initial tension is reversed, when it becomes a Rodman gun, and is thereafter to be considered as liable to burst in the same manner. The Dahlgren gun would stand but few rounds with heavy charges of fine powder and solid shot. It is, in fact, as it is called, a shell gun. I believe it to be the best gun in the world, not excepting the English sixty-eight pounder, for attacking earthworks from wooden ships, or for a combat with other wooden ships. It is far inferior to the English sixty-eight pounder for battering purposes; and for assaulting iron-clads, it is good for nothing.

Considering it is prepared for use, by careful firing with shells, to change its character to a Rodman gun, it will then endure, as will any other gun with initial tension, one or two heavy charges, occasionally; but, like all others, it cannot in that state be fired rapidly with heavy charges, or it will burst.

The cast block from which the Dahlgren eleven-inch gun is made weighs sixteen tons—the gun but eight tons. Nearly half of the material (the best charcoal iron, now very scarce and expensive) is thus wasted by being cut away into fine chips of very little value.

UNEQUAL COOLING.

A fifteen-inch Rodman gun, cast hollow, and cooled from the exterior to get initial tension, at Pittsburg, a few months since, when nearly cold and ready to be removed from the pit, split from end to end. The inner metal had been cooled by water passing through the bore while the outside metal retained a higher temperature. By this means Colonel Rodman attains initial tension in his gun, as in the hooped guns of Parrott, Armstrong, Blakely and Brooke.

The outside metal cooling at a later time shrinks upon the inner metal like the tire upon a wagon wheel, but in the

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case referred to the tension was too great. The cast block was about sixteen feet in length, and the wall about sixteen inches in thickness—consequently the area of cross section ruptured was equal to 3,172 inches. If the tensile strength of the metal was 30,000 lbs. to the square inch of section, the pressure bearing upon the inner metal was about 95,000,000 of pounds on each side, or a whole pressure of 190,000,000 of pounds.

I acknowledge this to be a somewhat exaggerated statement, as the cast block was longer by the length of the sinking head than the gun, and part of the outside metal in a state of tension is turned off along the chase.

As the gases of powder act upon the bore of a gun *when the cartridge has windage*, or when *the shot is not home*, with increased force—(their *vis viva*)—it is necessary, in a large gun, to make the walls sufficiently thick to withstand it; which it is possible to do. It is and has been done from all kinds of material heretofore used—bronze, cast-iron, semi-steel, and steel. But when the gun is so made, embodying initial tension, or put in that state of strain from the heat of firing, it bursts quite unexpectedly, from unequal expansion.

PRESSURE OF POWDER.

Professor Treadwell, in one of his pamphlets, informs us that Count Rumford estimated the pressure of gases of gunpowder when fired in a closed space filled with the powder to be 50,000 atmosphere, or about 750,000 lbs. pressure upon the square inch, and says: "my own experience in bursting guns, the strength of which was known to me, leads me to think he has not over-estimated it." Rodman, by the use of an instrument, measured certain forces of powder in guns, and called it pressure. It was, in reality, the *vis viva* of the gases* and part of the instrument that

*Col. Rodman makes a labored effort to show that his instrument gives the simple pressure of the powder. This has been disproved and ridiculed

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he measured, and gave from 10,000 to 87,000 lbs. pressure upon the square inch: a remarkable want of uniformity where most of the results given are *means*.

It seems to have appeared necessary to those projecting guns to attribute an extravagant amount of pressure to the gases of powder and great irregularity of intensity, thereby to account for the bursting of the guns.

Supposing the gun that split at Pittsburg had happened to have been safely removed from the pit and finished as a gun and proved, (the process in the manufacture of this gun was the same as in all other guns of this class,) would Colonel Rodman have deducted 190 millions of pounds, or any other sum, from the estimated pressure of the powder as an allowance for this strain upon the gun if it had burst? If he had done so, he would not have the simple pressure of the powder left; for a gun in the state of strain in which that gun is proved to have been, would require but little heat applied to the surface of the bore to burst it without pressure of gases inside at all

It is not a wonder that such guns burst. The wonder is that any of them endure firing powder in them at all.*

These guns, however, are always fired slowly. Awkward loading apparatus is always supplied with Army guns, and let the gunners make all the haste possible, they can fire but four shots per hour from them.

The loss of efficiency from slow firing is shown in this manner: The Dictator, turret iron-clad, has but two guns, fired once in fifteen minutes each, giving one shot in seven-

by Professor Treadwell and others. The *vis viva* of the *gases* is the most severe strain ever exerted on a gun. The estimate of simple pressure I have made is the usual force; the *vis viva* the extraordinary force. The *vis viva* of the gases and part of the instrument is like the force of the projectile, and is never exerted upon the gun from which the shot is fired—the momentum of the shot being the force and the time of the action of the force: shown not to be expended upon the gun, because it is expended in another manner. When guns burst, the shot is projected the usual distance.

*It is reported since the foregoing was written that a large additional number of the guns have been found disabled.

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and-a-half minutes. The Minnesota, a broadside ship, with fifty-two guns, can deliver a shell from each gun every half minute, or about one hundred charges per minute—equal to seven hundred and fifty Dictators, and one Dictator costs equal to two Minnesotas. And what chance would a Dictator have in combat with a broadside ship, if at close quarters, projecting fifty or sixty shells per minute at and into her ports.*

Slow-burning powder is used in fifteen-inch army guns; extremely small charges in the navy guns.

MAMMOTH POWDER.

The mammoth powder does not all burn in the gun. I myself picked up a handful of partly burned grains in front of a fifteen-inch gun, after firing three rounds, each grain of which bore evidence of having *been on fire*, and of course of having had the fire *go out*, for it was not all consumed; upon being lighted again, such remnants of grains of powder exploded, apparently as rapidly as before being put into the gun. Quite a perceptible time is occupied by such grains in being consumed, hence the name slow-burning powder.

AN INSIGNIFICANT ESTIMATE.

I am of the opinion, and I have given a long and patient study to the subject, that the simple pressure of gases of gunpowder in a gun never exceeds ten thousand pounds upon the square inch, and that usually it is less than five thousand, dependent upon the weight of the projectile and the rapidity of combustion of powder; and that the temperature of the gases is about five thousand degrees—twenty-seven hundred degrees of heat melts cast iron,—but the surface of the bore is exposed to this temperature only about the two hundredth part of a second for one discharge. When guns

* Admiral Farragut was enabled to silence the enemy's guns when entering Mobile, so that they could not return his fire. How many slow monitors, with fifteen-inch guns, would be required to perform that feat?

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are fired slowly, the heat is distributed throughout the mass of metal, or radiated away from the surface of the bore; and experimental firing is usually performed with the greatest deliberation. In proving guns, the gunners and inspectors are ensconced in a bomb-proof, to which they retreat, or else retire to a distance—so the rapidity of fire that is necessary in the excitement of actual battle seldom occurs during proof: consequently guns are not proved, and do burst in action.

BURSTING BY PRESSURE.

When the steamship Great Eastern was launched, Brahmah or hydraulic presses were used of ten-inch calibre, and with ten inches thickness of walls of cast iron—consequently these presses had the usual proportion of thickness of walls in a ten-inch gun. Ten-inch guns have been fired with double-shotted charges without bursting. The press cylinders burst as often as five thousand pounds pressure to the inch was applied on the occasion alluded to.

Major Wade and Major Hagner conducted experiments at Springfield Armory, in which water pressure was applied at different points in the length of musket barrels. Twenty-five hundred pounds to the inch would permanently enlarge a musket barrel in the "thinnest part, near the muzzle, and five thousand pounds to the inch would permanently enlarge it in the strongest part;" a result, says the report, never attained by the proof charges of powder and bullet.

In all these examples, five thousand pounds to the inch had a greater effect upon the barrels or cylinders, both of large and small sizes, than the simple pressure of powder.

Such examples as these coming within my knowledge, gives me the confidence to make the statement of opinion about pressure of powder above, which is, however, very different, I know, from the usual estimates, but not more different than one estimate of those who have written on

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this subject is to that of another. The previous estimates I have seen, from Robins and Hutton to the present time, vary from fifteen thousand to seven hundred and fifty thousand pounds to the square inch. Some of even the most moderate estimates give a pressure that, if applied to but one inch of the surface of the bore of a gun, would punch a hole through it. What, then, would be the effect if applied to the whole surface?

THE AMES GUN.

The Ames wrought iron gun, made of a very ductile metal, has not burst during a severe trial, which no other rifle gun in our service could bear, to which it has been subjected, but it is disabled. General Gilmore informed me that it was so enlarged at the fiftieth* round that the enlargement could be seen on the outside without the use of instruments. The inner metal, expanded by the heat of firing, stretches the outside of such guns; afterwards, when equilibrium of temperature is attained, the outside will stretch the inside, both enlarging its diameter and increasing the length of the gun. If it should now be re-bored and fired thirty rounds in fifteen minutes with the ordinary charge, at an elevation of ten or fifteen degrees, on a cold or damp day, I should fully expect it would burst. It is an expensive gun, but is more reliable than others. It is creditable to Mr. Ames to have succeeded in constructing such a superior heavy forging, without flaws; but, for guns costing so much money, (for many are made and but few are used in actual battle,) upon which the fate of the nation may sometime depend, we must have absolute reliability, both against bursting or enlarging, no matter how they are fired. We owe it to our reputation as a people, renowned for our energy, ingenuity, and skill, that we should not only equal, but far excel all other na-

*Should be four hundred and fiftieth; had the gun enlarged so early, it would probably have burst before the five hundredth round. General Gilmore speaks highly of these guns in his report. This gun undoubtedly began to enlarge with the first round.

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tions in the perfection of our material of war. It is cited, to our disgrace now, that we have been engaged four years in a most formidable war, taxing the utmost efforts of our people; and yet, it can be said to-day, that no single unquestioned improvement in the material of war has been officially adopted since the war began.

Thus it will be seen, that it is impossible to make an absolutely safe gun by any of the old systems, viz: by using strong material for great tensile strength, is always accompanied by high density; if we make the gun, embodying initial tension, the circumstances of firing destroys it; if the outside metal is ductile, by stretching the outside bands, or by breaking them if rigid; if the gun is made on the Dahlgren system, the conditions are not the same at any two rounds; if the inner tube is thin, as in the Whitworth or Armstrong, it will slip within the enveloping bands and project at the breech by the lengthwise expansion, while, at the same time, the bands will be stretched or strained radially; if the inner tube is prevented from extending by screw threads, as by Treadwell; by a shoulder or outside bolts, as in some of Blakely's guns, and in the Mallet monster mortar, transverse fractures of bolts or bands must have occurred in all cases.

The remedy for all these errors of construction is obvious, and is shown in the system I have been pressing upon the attention of the Ordnance Departments for two years or more, namely: to make a gun with a thin inner metal, and surround it with elastic webs, on which the re-enforce presses with initial tension, equal to the full pressure or *vis visa* of the powder, acting to enlarge the diameter of the tube. The pressure or *vis visa* of the powder can be restrained, but the expansion of the inner metal cannot, and it should be permitted, as it will not detract from the ability of the gun to project the shot. My plans provide for expansion of the inner metal both longitudinally and radially, while the initial tension of the re-enforce performs its function the sam

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whether the inner metal is expanded by heat or contracted from its absence.

WHITEWASHING.

A board of naval officers are now sitting in secret, to get information upon one of the most important questions of the day, a question in which is involved the expenditure of many millions of money, and on which the liberty and integrity of the country may depend. This board is brought here prematurely from a great distance, to enquire into the cause of failure of guns on board the fleet off Wilmington, before any particulars of the disaster are received. Not one of the board know or can learn, for some time to come, (not having the number of the guns) at what time they were fabricated, how much work each has done, or how rapidly they were fired. It would seem that the board was thus hastily convened, lest Congress should inaugurate some enquiry into the subject.

The importance of the subject demands that full information about these guns should be before the board and open to the inspection of experts, that experts and officers should be examined in public, and in presence of each other; that facts and opinions should be open to discussion and criticism. Truth is open and above board, and likes the light of day.

The manner in which this Government has been supplied with guns, and the quality of the guns, is a question in which every citizen has an interest.

Thirty thousand Springfield muskets are thrown away on one battle field, which from nervous panic on the part of the soldiers, or from the inefficiency of the arm, (for twenty rounds so foul them that they cannot be longer loaded, and after five rounds their accuracy is gone) each withdraws one soldier from ability to assail, but leaves him to be assaulted, killed, or wounded, or changes him from a marksman to a target for the enemy, and the gun is then thrown aside as useless.

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Twenty millions or more of rounds of bullets, shot and shell were projected against and into Vicksburg—enough to pave the ground within the enemy's lines; yet the enemy were but little hurt. We looked with surprise and in vain for the expected evidence of the effect of our bombardment after the siege was over, and we captured the city finally by cutting off supplies. On the 3d day of March, 1863, three turret iron-clads engaged Fort McAllister for eight hours, inflicting but little injury to the works.

What has always seemed the impending fate of Fort Sumter and Charleston has kept the people of the North in a breathless suspense of sympathy for two years. In April, 1863, the fort repulsed an attack of nine iron-clads in forty minutes, disabling five of them. Our military and naval forces have been threatening them monthly with utter annihilation, to be rained upon them in terrific showers of Greek fire, shells and shot, from PARROTT GUNS. "Man never is but always to be blessed." Charleston still exists intact, and Fort Sumter frowns upon us as defiant as ever. A most degrading result to our boasting. Tooting on horns in these days, it would seem, does not cause the wall of a city to "fall flat," so that the people can go up and take it.

At Fort Fisher, by the bursting of our guns,* more of our own men were killed or wounded, and more of our own property destroyed, than of the enemy's.

All this points to the necessity that we should devise some means by which the system upon which our ordnance is obtained shall be improved, and it is also necessary that we should devise a uniform system of ordnance for the army and navy.

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*Two fifteen-inch navy guns have just burst during the second assault on Fort Fisher. N. B.—Two out of twelve (that being the whole number of guns of that size on the monitors of the fleet) burst the first time they have been fired rapidly. All accounts concur in saying the firing was rapid; from these twelve guns, twelve shots in three minutes: or one in three minutes from each gun of this size.

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It is necessary to have but one Ordnance Department or committee charged with the duty of procuring guns and ordnance stores, leaving to the present bureaus the duty of supplying the guns and stores so procured, of keeping the accounts of issue and consumption, and of perfecting the service of our guns so procured, with which duty it is quite proper two bureaus should be charged—one for the army, and one for the navy.

An ordnance joint committee should be organized at once, to be continually in session, and have charge of establishing a uniform and reliable system of ordnance. All the acts of the committee, all the proposals or objections, theories, drawings, specifications, or contracts, should be open to inspection and criticism at all times by all persons, whether officers, experts, manufacturers or inventors.

Such committee should first fix upon a uniform system of calibres.

Then begin *de novo* by asking for plans, specifications and estimates, from ordnance founders, practical mechanics and inventors, to be so placed on file that rival applicants can see and criticise whatever is presented to the committee.

Then obtain the guns according to the plans and specifications decided on, from the lowest and best bidder, subject to test and inspection.

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APPENDIX.

SOLID CHUNKS OF WISDOM.

PARROTT RIFLED GUNS.

"In answer to the House resolution of the 5th instant, in relation to the bursting of the Parrott guns on board the fleet in the first attack on Wilmington, the Secretary of the Navy yesterday sent to that body the following communication."—*Intelligencer.*

NAVY DEPARTMENT, January 19, 1865.

SIR: I have the honor to acknowledge the receipt of the resolution of the House of Representatives, passed on the 5th instant, requesting the Secretary of the Navy to communicate to the House, so far as he has knowledge, "what number of guns were burst on board our fleet in the late bombardment on Fort Fisher; on what ships they were mounted; the cause of their failure; the number of persons killed and wounded thereby; and whether any of such guns were of wrought iron construction?"

From information received thus far it is ascertained that five Parrott rifled guns burst on board our fleet during the bombardment of Fort Fisher, on the 24th, 25th, and 26th of December, 1864; that they were mounted, one each, on board the Ticonderoga, Juniata, Mackinaw, Quaker City, and Yantic, and that forty-five persons were reported to have been killed and wounded thereby.

The cause of their bursting cannot be determined for want of further data.

None of these guns were entirely of wrought iron construction; they were of cast iron, strengthened at the breech by a wrought iron band.

Very respectfully, &c.,

GIDEON WELLES,

Secretary of the Navy.

Hon. SCHUYLER COLFAX, Speaker of the House of Representatives.

BATTLE OF FORT FISHER—ADMIRAL PORTER'S OFFICIAL REPORT.

North Atlantic Squadron, United States Flag-ship Malvern,
Off Fort Fisher, January 17, 1865.

* * * * * * * * * * * * *

I believe we have burst all the rifled guns left in the fleet (one on the Susquehana, one on the Pequot, and one on the Osceola), and I think the reputation of these guns is now about ruined.

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COMPRESSIBILITY OF METALS.

If a sufficient pressure is exerted upon four sides of a cube of cast iron, bronze, steel, wrought iron, or india-rubber, it will be extended in the directions of least resistance. A roll of india-rubber is extended in length by compression under a grasp of the hand, while india-rubber is as incompressible as water. A cube of rubber cannot be made to occupy less space by equal pressure on all its sides. The following is a list of materials in the order of their compressibility:

1. SPONGE.
2. LOW CARBON CAST-IRON, of which the English 68-pounder is made. The charge for this gun is twenty-five pounds of powder, more than one-third the weight of the shot; tensile strength 18,000 pounds to the square inch of section.
3. LOW AMERICAN CHARCOAL NEUTRAL CAST-IRON, of which the Dahlgren XI-inch gun is made, charge 15 pounds of powder, 135-pound shell—one-ninth; and the Rodman XV-inch gun charge 35 pounds No. 7 powder, shot of 450 pounds—one thirteenth; tensile strength 30,000 pounds to inch of section.
4. ANCIENT BRONZE gun metal tensile strength 40,000 pounds to inch of section.
5. MODERN BRONZE OF THE WASHINGTON NAVY YARD, tensile strength 55,000 pounds. This metal has about the same tensile strength and ductility as the wrought iron of the Ames' gun. If the bore of a large gun of this metal were enlarged by water pressure, when bored nearly to the proper size, then re-bored, it would make a better gun for less cost. 1st. Better because of the superior heat conducting power of bronze, it would be heated in all parts more nearly alike, and cooled in all parts more nearly at the same time, thus returning nearly to its original dimensions after firing. 2d. Better for the reason of the possibility of securing uniformity in fabrication; and 3d. Better on account of the superior value of the material of which it is made for re-casting into other guns when disabled.
6. WROUGHT-IRON, of which the Ames' gun is made, test pieces taken from large masses, 40,000 pounds; small masses well worked, 60,000 pounds. There is no fibre to large masses of wrought iron as claimed, and except where welds are imperfect, no difference in the longitudinal or transverse strength.
7. SEMI-STEEL, tensile strength, large masses, 75,000 pounds; small masses, well worked, 110,000 pounds.
8. HIGH AMERICAN NEUTRAL CHARCOAL CAST-IRON, tensile strength 38,000 pounds to inch of section; guns of this metal have no endurance.—(See Rodman's book, pages 137 and 138.)
9. FRANKLINITE OF NEW JERSEY.
10. GLASS.
11. INDIA-RUBBER.
12. WATER.

THIN WALLS.

We never hear of a musket barrel or a small field gun bursting, except there are flaws in the metal. So I have had a thick glass globe on a gas lamp fly to pieces when the gas was lighted, heating the inner surface suddenly, (glass is a bad conductor of heat); a thin one will not break.

UNEQUAL EXPANSION.

Our old fashioned box stoves with flat plates were always cracked the first time a fire was put in them, no matter how thick the plates. A stove

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made in the same manner with thin plates, panneled or ornamented with carving in relief, the plate being of uniform thickness or thinness, does not crack by years of use, *the plates bend.*

CURIOUS EXAMPLE.

In 1855 I made a heavy pile hammer, in Chicago, for a contractor on the Illinois and Michigan Canal, which was removed from the mould in the Foundry too early and placed on a paving of brick on the deck of a canal boat for transportation to Joliette. It was so hot when put on board that it set fire to the deck about two hours after, while *en route*; in dashing water under it upon the deck, some was thrown upon the hot iron, cooling parts in advance; at a later time, when the heat left the interior, it burst in two parts, and each piece was thrown to the bow or stern, and passing down through the bottom, sunk the canal boat. The report was heard two miles.

ANOTHER.

I frequently experiment with glass models of guns which I have subjected to a water pressure of eight hundred pounds pressure to the inch of surface in the bore. These are broken in many pieces by inserting a heated rod of iron smaller than the bore in such a manner as not to touch the surface.

STILL THEY COME.

The great Mallet Mortar, made of a series of rings held together by six strong bolts, was disabled by the lengthwise expansion of the rings breaking the bolts.

A FACT.

One of Blakely's, guns made with four bolts reaching from the trunnion ring to the cascabel, broke the bolts in the same manner.

"At this round the four bolts gave way—the four united being equal to a solid bar the size of the bore. *The rest of the gun was uninjured.* * * I had this gun re-made with four bolts of the best charcoal iron, but they too broke without injury to the tubular part."—*Paper read by Capt. Blakely before the United Service Institution, England; vol. III, Journal.*

A PERTINENT FACT.

The inner tube of the Whitworth gun shown in Gen. Gilmore's report, increased in length by the heat communicated to it, and closed the vent. If the bands had been fastened by screw threads, as recommended by Prof. Treadwell, the bands would have parted transversely as did the bolts of the Blakely gun.

A three hundred pounder Armstrong gun in which the breech piece was inserted by screw threads within the principal reinforce band abutting against the inner tube of steel, was burst by the lengthwise expansion of the inner tube, pushing out the whole breech, breaking the reinforce band transversely.—(See Holley's book.) Compare this example with the Whitworth gun shown in General Gilmore's report, and with those Parrotts that have failed at the breech, and see the analogy. When a Parrott gun is strained radially as well as longitudinally forward and under the band by the heating inside, the reaction of the forces having a tendency to push out the breech also tend to push outward and forward the slab of

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the cast-iron re-enforce that leaves the gun forward of the band or wrought iron hoop, and in this effort the pressure of the powder assists; hence the forward reinforce fractures, and when the band also breaks, the cause is obvious.

ONE MORE.

A Dahlgren gun fired at Reading, had a crack exhibit itself on the outside first, and burst at the next round. The metal was probably too high, and the gun was new.

EASY TO COMPREHEND.

About a year since some granite columns were standing at the corner of Pearl and Fulton streets, New York, being the ruins of a fire. These columns were originally square but the corners had been broken off by the expansion, as they were heated while the building was burning, and they were left nearly round.

AN OLD STORY OF 1863.

"No little amount of surprise is expressed by inexpert persons that the acknowledged difficulty of making large guns is not overcome by using stronger materials, as, for instance, wrought-iron or steel in the place of cast-iron. Ordnance officers excuse this discrepancy on the plea of the impossibility of perfectly welding large masses, and often speak of the "mysterious force" of gunpowder. Professor Treadwell, of Cambridge, Mass., shows distinctly how large guns may be made of these strong materials, and triumphantly points out by calculations which can not be disproved, that the *pressure* of gunpowder can be resisted by guns made upon this plan, even upon the supposition that the pressure is enormous; but his imitators, in carrying out his theory, have failed as often as others have done before; an evidence that the guns fail from some cause not understood, and other than the direct pressure of the powder. The Parrott rifle gun is made upon the Treadwell plan, badly carried out to be sure, but it does not insure the guns from bursting, as the 100 pdr. Parrott on the steamer Naugatuck burst in service on the James river, before Fort Darling; and another of these 100 pdr. Parrott rifles burst soon after on the ill-fated steamer Westfield, in the Gulf of Mexico. And many of the 200 pdr. Parrotts having failed, they are looked upon with suspicion by our most experienced officers. These Parrott guns are the only large rifle guns in the service.

SOME OF DAHLGREN'S FAILURES.

It is true that Capt. Dahlgren, the present chief of the Navy Ordnance Department, made a very extensive and costly attempt at the commencement of the rebellion to produce cast-iron rifle cannon and projectiles from plans of his own, of the following sizes: 30, 50, 80, and 150-pounders.—Contracts were entered into with Messrs. Knapp & Rudd, Pittsburg, Pa.; Parrott & Co., West Point, Foundry, N. Y., and Cyrus Alger, of West Bos-Boston, Mass., for 150 blocks, to weigh each 23,000 lbs. in the rough, to be finished with a calibre of 7½ inches. and designed to throw shot weighing 150 lbs. I received an order from the Navy Ordnance Bureau to finish fifty of these guns; seven of the blocks were delivered to me, three of which were entirely finished, and the balance were ordered to be returned unfinished. as the various trials at the West Point Foundry and elsewhere demonstrated these guns to be entirely unreliable. The blocks upon

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which I commenced work were from the Pittsburg and West Point Foundries, and were of the two quailities, *high* and *low* cast-iron, specially adapted for gun metal, with a tahsile strength of from 32,000 to 34,000 lbs., to the square inch. Thirty or forty of these blocks were delivered, and had more or less work performed upon them, quite a number having been finished. This costly effort of making 150-pdr. rifled guns proved an utter failure, as not one of the guns has proved serviceable, and no better success attended this officer's attempts to make 80-pdrs. One hundred of the massive blocks for this class of guns were ordered from one establishment, while an *unlimited* order was given to another. Forty or fifty of these blocks were delivered, and many of them finished. None of them are in service, and these too must be added to the list of costly failures in attempts to make cast-iron rifled ordnance. Of the 50-pdrs., 100 blocks were ordered from one establishment, and 50 from another. A few of these guns were put in service, but their liability to failure has, I believe, induced Capt. Dahlgren to withdraw them, and at this time I believe there is not one of them in service where they are likely to be used. Seventy or eighty of these blocks were delivered. Of the 30-pdrs., 100 blocks were ordered, and of these forty oi fifty were delivered. The Parrott 30-pdr. takes their place in the navy, as they were found to be unreliable. This is but one among many costly and unsuccessful attempts made at the Washington Navy Yard by the present chief of the Bureau of Ordnance, while acting as the commardant and designer of ordnance at that establisment. In his costly attempts to produce an effective "Dahlgren Rifle Projectile," the present chief of the Ordnance Bureau has been as unfortunate, and has failed as signally, as he has in his attempts to make serviceable rifle guns—as, in fact, have all other ordnance officers, as all of their attempts in this direction have proved impracticable and worthless, or have interfered with patent rights of private citizens.—*From "Great Guns," pages* 10, 11, *and* 12.

REAR-ADMIRAL DAHLGREN WANTS TO COME TO THE FRONT.

Admiral Dahlgren, I have been lately informed, is disgusted with his command at Charleston, and is making efforts to be relieved, expecting to return to Washington to his old position of the great factotum of ordnance to the navy, now that Parrott guns are discredited. Look at the record above of his failure to produce rifled guns. Col. Redman sits at the right hand of the chief of ordnance of the War Department, and if Admiral Dahlgren succeeds in his aspirations, we shall have a pretty state of things in our two Ordnance Departments—army and navy—in which the rebels and public enemies will be forgotten, and the old bitter feuds of rival official gunmakers and patentees revived. In this state of things, "errors will be perpetuated, pretentious ignorance exalted, and false reputations confirmed;" but we will get no reliable guns. It is to be hoped that no such incubus will be allowed to longer attach itself to this great Government.

WITHIN THE RING.

The Ordnance Department have caused a large number of 32-pounder smooth bore guns to be rifled, adapting them to Parrott projectiles, and this process is now going on at the arsenal in Washington; some, perhaps all, of these were servicable guns before rifling, but every type knows they are utterly useless now, and it is not probable one of them will ever be fired in service. The question arises why has this been done, and is partly answered when we know that immense numbers of Parrott projectiles

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have been ordered for them from the West Point foundry. I assert, without fear of contradiction, that there is not an experienced Ordnance officer in our service that will make the statement that he believes these guns are even comparitively safe. I do not believe we have an Ordnance officer who will venture to stand by one of them when it is fired. Is it the intention to put these guns into service to kill our own men? Was this fraud perpetrated after the Parrott guns burst on Morris Island, to show, at some future time, that other than Parrott guns burst; or was it for Col. Rodman's benefit to show that guns cast solid, a la Dahlgren, burst; or was it simply to get a base on which to give Parrott a large order for shells?—*quien sabe.*

SMITHSONIAN.

After the late fire at the Smithsonian Institute, a number of my friends remarked to me that they saw my theories verified by the bursting of the brick tower by the heat inside. As in guns, the inner surface of the brick was heated and extended, causing longitudinal cracks, throwing each half outwards in a curve. Had the top of this tower been as thin as to be heated through, like the chase of a gun, its length and diameter inside and out would have been extended alike. The longitudinal crack would only have extended up to that point where the brick was not heated through the whole thickness; where the crack would have divided, branching off to either side, as in guns just forward the re-enforce.—*See "Great Guns, page* 48."

GOVERNMENT FOUNDRIES.

"No better argument can be used in opposition to the proposed appropriation of millions of dollars, for the purpose of establishing great Government foundries for the production of cannon, and confirming officers in life-long sinecure positions, than the acknowledged fact that all governments which have trusted to the skill and ingenuity of a privileged class, or to one person to decide upon or to furnish designs and improvements in ordnance, have signally failed, as in the case of England. Sir William Armstrong having, according to computations, cost that government over forty millions of pounds sterling for experiments upon his inventions. Yet his large guns have always failed, while Whitworth, Blakely, and others, private citizens, without government patronage, have succeeded in producing better guns, as might have been expected, since no man so earnestly strives for success as the one who pays his own bills. It is a national disgrace, that a people who justly pride themselves on their mechanical ingenuity and skill, should intrust the invention and fabrication of so important an auxiliary to their unity, power, and national greatness as Ordnance, wholly to a class of persons who have been educated as theorists. It is as difficult to teach mechanical ingenuity in schools, as it would be to communicate the inspiration of a poet in such places. We have no schools for the specific purpose of making poets, why then should we expect in such places to create or incite the equally *divine* inspiration of mechanical genius.

We can, and we should adopt a system which would produce guns that would as completely answer the purpose for which they are intended, as our most common agricultural implements answer the end for which they are designed.

What farmer would long continue to purchase ploughs of a manufacturer, whose productions were liable to fly in pieces at any extra strain, while turning a furrow, killing the plowman, destroying the team, and tearing down buildings."—*Memorial of Norman Wiard, February*, 1863.

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EGOTISM.

I have devised a system of ordnance, the guns of which are near the ordinary form and would require no change in the carriages, implements, service of the gun, or manner of mounting. The guns are to be made of cast iron, and are of cheap construction, and have initial tension, but with elasticity between the inner metal and the reenforce sufficient to permit the expansion of the inner metal by the heat of firing, radially and longitudinally. I have submitted the designs to many intelligent officers and to practical mechanics, all of whom agree with me that I get greater strength to restrain the pressure of the powder in this gun than is attained in guns of the ordinary construction, of same weight. While those whose judgment I respect, and who have examined the subject carefully, believe that this plan provides for the distertions of unequal heating, when fired rapidly or otherwise. By adding to the weight of the gun I can increase its strength almost without limit. I feel quite confident that having first discovered the real cause of failure of guns, I have been enabled to provide the remedy, and that guns made upon my plans, when properly proportioned and fabricated, can be fired with charges as heavy as desirable and as rapidly as it is possible to load them with absolute immunity from bursting. Upon this plan the strongest metal will make the strongest and best gun, hence old or burst guns may be re-cast into new guns without waste, for the gun is cast to its proper form and none of the outside turned off. In this a practical plan may be seen to utilize the failures of the past.

I had an order from the Hon. Secretary of the Navy for twenty-one guns to be made upon this plan, and based upon my success with the Navy Guns an unlimited order from the War Department. I represented to the Navy Department that I required three trials to produce a good gun of one size, and it was agreed to verbally that I should have three trials; when the contract was written, however, it provided but for two trials to which I assented upon the assurance that it was the intention of the department to deal liberally with me. I expended about $100,000 in preparation for the work, the guns being of the heaviest class. I made one gun and it failed for causes that can be satisfactorily explained. I made another; just before it was completed the order was countermanded and the contract annulled in so arbitrary a manner that I could not believe the officer who made the communication to me—Captain Aulick, Assistant Chief of Ordnance, had read it. I was afterwards satisfied he had however, from a second communication he made to me on the subject; but that he did not consider conditions of much account; and beside I do not think he is very fond of me for which I am sorry, as the effect of his decision not only annulled the Navy order but that of the War Department also.

A few weeks since I could say with truth that in the preceding year I had been engaged exclusively manufacturing for the Government in a ship yard, and an ordnance foundry, in which I had expended $400,000 cash. I had paid $11,600 Internal Revenue taxes and my receipts had been $5,600. The statement would not be much different now. I would like to "take in" a partner with a million or so of capital, if I am to continue the business.

EXHAUSTION.

The reader may be, but the subject or the author is not yet exhausted.

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"If a man can play the true Logician and have as well Judgment as Invention, he may do great matters."—BACON.

GREAT GUNS.

THE CAUSE OF THEIR FAILURE,

AND THE

TRUE METHOD OF CONSTRUCTING THEM.

ADDRESSED TO

THE PRESIDENT, THE MEMBERS OF HIS CABINET, THE MEMBERS OF THE SENATE, THE HOUSE OF REPRESENTATIVES, AND THE OFFICERS OF THE ARMY AND NAVY OF THE UNITED STATES.

BY

NORMAN WIARD.

New York:
HOLMAN, PRINTER, CORNER OF CENTRE AND WHITE STREETS.
1863.

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PREFACE.

HAVING made important discoveries relating to Ordnance and Artillery, and expended large amounts of money in illustrating them by designs and models, and in futile efforts to have some or all of them adopted into the service of the United States, I have concluded that no one not connected with the regular army or navy has any possible chance to succeed in such an effort, *no matter how much merit there may be in what he proposes; no matter* how much *commendation* his proposals may receive from parties other than the *regular* officers of the Ordnance Department or service; and, *no matter how urgent may be the necessity* for such improvements, UNTIL THAT TIME ARRIVES WHEN MEN OCCUPYING OFFICIAL POSITION CAN INTRODUCE SUCH IMPROVEMENTS AS THEIR OWN, after having disgusted and ruined the original inventors, and driven them from the seat of government to the obscurity of their homes.

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With these views, I have determined to publish, in a series of pamphlets, of which this is the first, the most important of my discoveries, and, as an introduction to the subject, the course of reasoning by which I arrived at my conclusions; illustrated, as far as possible, by familiar examples; so that the Heads of the Government, members of Congress, and the People, may understand how much official encouragement such improvements do receive, and judge for themselves how to secure to our country the benefit of the ingenuity, skill, and enterprise of its mechanics and private citizens.

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GREAT GUNS;

The Cause of their Failure, and their True Method of Construction Considered.

To the President, the Members of his Cabinet, the Members of the Senate and House of Representatives, and the Officers of the Army and Navy of the United States.

INTRODUCTORY STATEMENT.

In a military point of view it has been well said, that nothing could do more to assert and establish the dignity and material power of a nation, than the possession of the most effective artillery.

At the beginning of this atrocious rebellion of the Slave Power, the loyal millions of the North rallying round their government, believed that our great preponderance of wealth, of material resources and of numbers over the rebels would enable us to win easy victories and speedily crush out the southern conspiracy against the life of the nation.

We supposed that we possessed the ingenuity to invent, with the skill and facilities to construct engines

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of war, that would so far excel those which the traitors would be able to obtain, that we naturally expected our triumphant success would be prompt and certain. But these anticipations have not been realized. Before the rebellion commenced we had the Springfield rifle musket, Sharp's carbines, Colt's pistols and Dahlgren's 11-inch shell gun. We have nothing in service to-day better or more efficient, and the rebels are our equals, having all these and others as good.

Great changes in this and foreign countries, have been introduced in naval architecture, and proposed for fortifications, by the construction of iron-clad ships and revolving forts. These changes involve the necessity for guns of calibres to project heavier shot at much higher velocities and consequently longer range than have been heretofore employed, and so constructed as to be reasonably safe from bursting when used in confined turrets, casemates or on the decks of ships. Yet our 10 and 11-inch cast-iron smooth-bore guns, (by no means safe, many of them having burst with very small charges,) are the best guns we have at present in service, although many have the impression that the fifteen inch cast iron Rodman gun, called Dahlgren or Erricson, since being placed on board the Monitor iron-clads, is a more powerful gun, while, in fact, with it, there never has been and never can be attained the penetration of iron plates that has been attained by the 11-inch shell gun, viz.: four and a half inches.

A shot projected against iron plates with a velocity

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of 1,000 feet per second, is subjected to the resistance of its passage through the iron a certain period of time. If it were projected against a plate at a velocity of 2,000 feet per second, it would be subjected to the same resistance, but only half the time for the same thickness of plate. Consequently, on account of the time of resistance, it should have twice the penetration, and on account of its momentum being doubled, for twice the velocity, it would penetrate four times as far. In other words, the penetration is as the square of the thickness for double velocity. If then a shot from an 11-inch gun, with a velocity of 1,500 feet per second, penetrates four and a half inches, what would be the penetration of a shot from the 15-inch gun, with a velocity of but 750 feet per second? When a shot passes through a plate, it drives before it a piece the form of which is a frustrum of a cone, the smallest diameter of which, is about the diameter of the shot. The resistance to its passage is as the circumference or the *sheared area.** Considering its form, it will be seen that the sheared area increases in a ratio greater than the thickness. From this cause the 15-inch shot would penetrate more than one-quarter of the penetration of the 11-inch shot; but if the 11-inch shot weighs 160 lbs., and the 15-inch shot 450 lbs., with these relative velocities, the crushing effect of the 11-inch

* I am indebted for the comprehensive expression, "Sheared Area," to the forthcoming work on "European Gunnery and Iron-clad Defences," by Alexander L. Holly, in press by Van Nostrand.

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shot would be represented by 640, in opposition to 450 of the 15-inch shot. The impact due principally to the velocity of the force represented by 640, acting upon the smaller surface of the plate, has been called "penetrating force," in contradistinction to the effect of the slow moving, but heavy shot, called "crushing force." Some other principles are involved in the calculation, which it is not necessary to mention, as, after considering them all, I conclude that both in the penetrating and the crushing effect the 11-inch shot is by far the greatest. It is not an advance, then, to adopt the 15-inch gun in preference to the 11-inch.

The ordnance officers, who have been specially detailed and largely salaried by the government, to make discoveries and improvements in ordnance, and who have taken out patents* for some alleged improvements, in their own names as private citizens, notwithstanding all the help afforded them by government, have done little or nothing to advance the science of gunnery; old errors are perpetuated and millions of money and thousands of tons of gunpowder have been wasted in bursting guns upon experimental or *repetition trials*, when all previous trying and experimenting had demonstrated their unreliability. It would seem as though *our* ordnance departments or bureaus were created to restrain improvement and to keep

* Captain Dahlgren has taken out several patents in his own name, for improvements in ordnance, while in the employ of the government, at the Navy Yard at Washington, the latest of which issued in July, 1861, experiments being conducted at the public expense.

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down and crush out the inventive genius of the country. Certain it is, that despite the unsympathetic and unwise policy of the government, and the undisguised hostility of these ordnance officers, often resulting in a total disregard of the rights of individuals and all principles of justice and patriotism, most of the practical and important improvements in the implements and material of war were conceived and perfected outside of the ordnance departments, by private citizens, who, notwithstanding the complications of routine, have developed the true principles which must, hereafter, govern the manufacture of ordnance and projectiles.

GENERAL IGNORANCE ON THE SUBJECT OF ORDNANCE

There is probably no other subject about which so much ignorance exists among all classes of the American people, learned and unlearned, as that relating to ordnance and the nature of the improvements supposed to have been made in the method of constructing guns; and it seems to have been the policy, in this country especially, to shroud the manufacture of large guns in mystery, and the knowledge obtained at the expense of the people has been kept from them as though of right, belonging only to a few ordnance officers of the army and navy, while every discouragement has been thrown in the way of the so deemed interference of outside inventors and manufacturers with new ideas.

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No little amount of surprise is expressed by inexpert persons that the acknowledged difficulty of making large guns is not overcome by using stronger materials, as, for instance, wrought-iron or steel in the place of cast-iron. Ordnance officers excuse this discrepancy on the plea of the impossibility of perfectly welding large masses, and often speak of the "mysterious force" of gunpowder. Professor Treadwell, of Cambridge, Mass., shows distinctly how large guns may be made of these strong materials, and triumphantly points out by calculations which can not be disproved, that the *pressure* of gunpowder can be resisted by guns made upon his plan, even upon the supposition that the pressure is enormous; but his imitators, in carrying out his theory, have failed as often as others have done before; an evidence that the guns fail from some cause not understood, and other than the direct pressure of the powder. The Parrott rifle gun is made upon the Treadwell plan, badly carried out to be sure, but it does not insure the guns from bursting, as the 100 pdr. Parrott on the steamer Naugatuck burst in service on the James river, before Fort Darling; and another of these 100 pdr. Parrott rifles burst soon after on board the ill-fated steamer Westfield, in the Gulf of Mexico. And many of the 200 pdr. Parrotts having failed, they are looked upon with suspicion by our most experienced officers. These Parrott guns are the only large rifle guns in the service.

It is true that Capt. Dahlgren, the present chief of

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the Navy Ordnance Department, made a very extensive and costly attempt at the commencement of the rebellion to produce cast iron rifle cannon and projectiles from plans of his own, of the following sizes, 30, 50, 80, and 150-pounders. Contracts were entered into with Messrs. Knapp & Rudd, of Pittsburg, Pa.; Parrott & Co., West Point Foundry, N. Y., and Cyrus Alger, of South Boston, Mass., for 150 blocks, to weigh each 23,000 lbs. in the rough, to be finished with a calibre of 7½ inches, and designed to throw shot weighing 150 lbs. I received an order from the Navy Ordnance Bureau to finish fifty of these guns; seven of the blocks were delivered to me, three of which were entirely finished, and the balance were ordered to be returned unfinished, as the various trials at the West Point Foundry and elsewhere demonstrated these guns to be entirely unreliable. The blocks upon which I commenced work were from the Pittsburg and West Point Foundries, and were of the two qualities, *high* and *low* cast iron, specially adapted for gun metal, with a tensile strength of from 32,000 to 34,000 lbs. to the square inch. Thirty or forty of these blocks were delivered, and had more or less work performed upon them, quite a number having been finished. This costly effort to make 150-pdr. rifled guns proved an utter failure, as not one of the guns has proved serviceable, and no better success attended this officer's attempts to make 80-pdrs. One hundred of the massive blocks for this class of guns were

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ordered from one establishment, while an *unlimited* order was given to another. Forty or fifty of these blocks were delivered, and many of them finished. None of them are in service, and these too must be added to the list of costly failures in attempts to make cast-iron rifled ordnance. Of the 50-pdrs., 100 blocks were ordered from one establishment, and 50 from another. A few of these guns were put in service, but their liability to failure has, I believe, induced Capt. Dahlgren, to withdraw them, and at this time I believe there is not one of them in service where they are likely to be used. Seventy or eighty of these blocks were delivered. Of the 30-pdrs., 100 blocks were ordered, and of these forty or fifty were delivered. The Parrott 30-pdr. takes their place in the navy, as they were found to be unreliable. This is but one among many costly and unsuccessful attempts made at the Washington Navy Yard by the present chief of the Bureau of Ordnance, while acting as the commandant and designer of ordnance at that establishment. In his costly attempts to produce an effective "Dahlgren Rifle Projectile," the present chief of the Ordnance Bureau has been as unfortunate, and has failed as signally, as he has in his attempts to make serviceable rifle guns—as, in fact, have all other ordnance officers, as all of their attempts in this direction have proved impracticable and worthless, or have interfered with patent rights of private citizens. Contracts were also made with me to furnish a large

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number of 50-pdr. semi-steel rifle guns, to be constructed upon the same models as the cast-iron 50-pdrs., the drawings being furnished by Capt. Dahlgren, through the Bureau of Ordnance, to me. I made ten forgings, and finished seven guns, of which five were absolutely perfect, notwithstanding it was supposed that it was impossible to manufacture solid masses of steel of the great weight required, viz., 7,000 lbs. One of these guns was put to extreme test, and was accepted and delivered.

The balance of the *first five* were ordered to be completed and delivered with the utmost dispatch. Two of them were completed, inspected, and submitted to a test of ten rounds and delivered at the Brooklyn Navy Yard, where they have remained ever since. Two others were measured with the star guage, inspected and made ready for firing; two others were submitted for inspection and test of firing. One of them burst on the tenth round, it having been fired very rapidly on a cold gusty day, but was found to be perfectly homogeneous and solid, and yet the tensile strength of the metal of all these guns was four times that of any cast-iron gun. The other, which from the great anxiety of the Bureau to have the guns before new machinery for boring and turning could be constructed, was finished at a workshop in Brooklyn, and the workmen engaged on it committed a fraud, by inserting a false chamber, to supply a defect caused by boring the block about two inches too deep. This gun was fired very rapidly on a

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cold day, and burst at the ninth round disclosing the fraud above mentioned, with which I had nothing to do, as the Navy Department has undoubted proofs from its Ordnance Inspector, Captain Hitchcock, but which was made the excuse for annulling my contract, leaving me for a time in a very undesirable attitude as a gun founder, and also for refusing to pay for the perfect guns, which had been inspected, tested, and delivered.

The Ordnance Bureau have seemed to me to withhold the settlement of my account for the purpose of deterring me from making this exposure, never positively refusing the settlement or completing it. I suppose I shall not now be kept long in uncertainty about their determination.

It would seem to be proper that I should endeavor to explain why rifled guns burst more frequently than smooth bore guns. Guns burst, as I will hereafter show, by the unequal communication of heat to the metal of the gun. The surface of the bore of a rifled gun is longer exposed to the high temperature of the gases evolved from the combustion of the powder as the gases are longer overcoming the inertia of the shot in a rifle than in a smooth bore gun, because there is a greater weight of projectile in proportion to the area against which the pressure acts.

The same liability to bursting is to be found in every description of gun now in use in the service, and to this day, after years devoted to experiment-

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ing, the cause remains as inexplicable to the ordnance authorities as ever. Voluminous reports have been frequently issued; elaborate and costly illustrated works have been published from time to time, and even recently, at the public expense, by prominent ordnance officers in this country, all of which throw no light upon the subject, but which, on the contrary, contain humiliating confessions, like the following, from Rodman's Report of Experiments upon Metals, p. 557:

WHAT IS NOT KNOWN.

"*Probability*, however, is not *knowledge*, but it is the *most* that can now be offered as well upon this (the difference in the endurance of guns cast and cooled in the same manner made from the same iron) as upon other points of equal importance.

"We do not *know*, for example, what qualities of iron are necessary to make the best gun; nor, if we did, do we know how, from any of its ores, constantly to produce iron which shall possess those qualities.

"We do not *know* whether guns should be cast hollow or solid, nor the proper rate of cooling for either mode of casting.

"We do not *know* the best exterior model for guns, nor whether those of large calibre should be made with or without chambers.

"We do not *know* the effects of time upon the endurance of guns —whether they are better when *new*, or after they have lain unused any given length of time.

"We do not *know* the maximum statical pressure due to a given weight of powder and shot, nor how much the rate of combustion of the charge, or the rate of application of the force, causes the bursting tendency to exceed that of the *statical* pressure.

"We do not *know* the difference in endurance due to a given difference in bursting tendency at each discharge, nor what weight of projectile is equivalent in bursting tendency to a given weight of powder, nor the difference in endurance due to a given difference in thickness of metal.

"We do not *know* the difference in bursting tendency due to a given difference in temperature of the same charge of powder at the moment of ignition.

"Nor do we know the proper constitution of charge in order to

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produce a given velocity of projectile with the minimum bursting tendency upon the gun.

"And it is believed that the true interests of the country would be promoted, in a military point of view, by entering, at as early a period as practicable, upon a series of experiments which would supply positive knowledge in place of probability in *some* and positive ignorance in *many* other points of the utmost importance to the national defense; *for it is better that millions should be expended in times of peace, and from an overflowing Treasury, than that a single gun should burst in action.*"

Having been engaged pretty extensively as a manufacturer of guns, and having had considerable experience in working metals previous to having my attention turned to this subject, viz.: the bursting of large guns, it became a matter of serious inquiry to me, to account for the fact that the *strongest metal did not make the strongest and most enduring gun*, as acknowledged in the following quotation from Rodman's book, pages Nos. 137 and 138:

RATIO OF GOOD AND BAD GUNS.

"Out of seven solid cast experimental Columbiads, one gun only proved to be good.

"Out of six hollow cast Columbiads, three were good, having been fired 1,500, 1,600 and 2,452 rounds respectively, and neither gun broken.

"It is not deemed out of place here, in order to show the necessity of further investigation into the properties of cast-iron, in its application to the manufacture of cannon, to notice some facts in the history of gun-foundering in this country since 1849.

"The very low endurance of the first pair (8-inch) of experimental guns which were cast in that year, was attributed to the inferior quality of the iron of which they were made.

"Two years were spent in searching after a *better quality* of iron, *which was undoubtedly found;* and in 1851 another pair of 8-inch guns were cast.

"The *iron* in this pair of guns had a *tenacity of near* 38,000 *lbs.;* while that of the iron in the first pair was only between 27,000 *and* 28,000 *lbs.*

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"The solid cast gun of the first pair burst at the 85th fire, and that of the second pair at the 73d fire; the superior iron giving the inferior solid cast gun.

"These results did not, however, destroy confidence in strong iron for solid cast guns, and the first pair of 10-inch guns was made from the same lot of iron; and with a tenacity of 37,000 lbs. the solid cast gun burst at the 20th fire. This result weakened confidence in very strong iron, and the tenacity was reduced.

"In 1857, after guns of good tenacity had failed at the Fort Pitt, South Boston, and West Point foundries, four out of seven guns offered for inspection at the last named foundry having burst in proof, Mr. Parrott, proprietor of the West Point foundry, one of our most experienced gun founders, cast his *trial* contract guns of iron, having a tenacity of 30,000 to 32,000. One of these guns has endured 1,000 service charges of 14 lbs. powder (800 rounds with shell, and 200 with shot.)

"The iron selected at that foundry and from which the five last experimental guns have been made, was of the same quality, and in the same proportions, as in the guns last above referred to.

"In 1858, after the failure, at the 169th fire, of the West Point experimental gun made from this iron, Mr. Parrott condemned it as being too *high* for heavy guns.

"From this rejected iron was made the last pair, Nos. 362 and 363, of trial 10-inch guns, at the Fort Pitt foundry, which have been fired 2,452 rounds each; the least charges fired being 14 lbs. powder and one solid shot, and neither gun broke. These guns have since been fired 1,000 rounds each with 18 lbs. powder and solid shot, and neither gun yet broken.

"It should also be borne in mind that the proprietors of the West Point foundry have the control of the smelting furnace at which their gun iron is made; they ought, consequently, to have a more perfect knowledge of the qualities and properties of their iron than those founders who are dependent upon the market for their gun iron.

"These facts, to my mind, are conclusive as to the fact that we are at present far from possessing a practical knowledge of the properties of cast-iron in its application to gun foundering; and it is too much to expect of private enterprise to take up and prosecute so intricate and expensive an inquiry."*

* Captain Rodman's experiments, continued at the public expense to relieve "private enterprise" from this oppressive expectation, has resulted in his securing a patent right for a process of making guns for which the government is now again paying as the guns are purchased. It must be conceded that we have a liberal government when it pays inventors a salary (in exclusive cases at least) for the time they are engaged in the invention; the cost of the experiments, including expensive implements, and the cost of the printed arguments by which the invention is introduced, not only in its own service, but to be offered to other governments with endorsement, and then buys the patented article.

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THE UNRELIABILITY OF ALL HOLLOW AND SOLID CAST-IRON GUNS.

My attention was also specially directed to the alarming uncertainty which exists as to the reliability or power of endurance of all kinds of iron guns, whether cast hollow or solid. The following extracts from Rodman's work, p. 134, giving the results of a long series of experiments, will show the necessity and importance of such inquiry:

"The results recorded in the tables shows the hollow cast gun in every pair (in which one or both guns have been broken) to be superior in endurance to the solid cast gun. The results may be grouped as follows, viz.: Of the two pairs of 8-inch guns, the solid cast guns endured 158 rounds—both burst. Hollow cast guns endured 1751 rounds—one gun unbroken.*

"Of the pair of 10-inch guns, fired with 18 lbs. charge, those cast solid were fired 564 rounds—both burst. Those cast hollow were fired 564 rounds—both burst.

"Of the two pairs of 10-inch guns fired with 14 lb. charges, those cast solid have been fired 2,851 rounds—one unbroken. Those cast hollow have been fired 4,052 rounds—neither gun broken.

"Of the pair of 32-pounders, the hollow cast gun was superior, but the comparison was destroyed by double charging the hollow cast gun.

"Of the three pairs of 10-inch and two pairs of 8-inch guns, when one or both of each pair has been broken, those cast solid

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* It will perhaps be noticed that Captain Rodman never acknowledges that a hollow cast gun bursts; he says, one gun unbroken in this case, and on page 137, he says, out of six three were good. And Captain Dahlgren, in his report to the Secretary of the Navy, December 1st, 1862, is very minute in his account of the endurance of certain of his guns, but does not mention the important fact that guns of the Dahlgren model ever burst. At the beginning of the war, it was the boast of Naval Ordnance officers that no Dahlgren gun had ever burst on board a United States ship—perhaps for the very good reason, there had been no very large guns fired on shipboard in actual shock of battle, or rapidly with full charges; 15 lbs. of powder is an insignificant charge for an 11-inch calibre with 138 lbs. of shell, and this was the highest charge used until lately. When 11-inch guns come to be fired rapidly with large charges, they will for the first time exhibit whether they are to be relied on or not.

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have been fired 603 rounds—guns all broke. Those cast hollow have been fired 3,915 rounds, and two guns unbroken.

"Out of the five 10-inch guns made of the same iron (that selected at the West Point foundry) two good hollow cast guns have been made; one having been fired 1,600 rounds, and the other 2,452, and neither broken; while of the three solid cast guns, two have burst, one at the 169th, and the other at the 399th fire; the other has been fired 2,452 rounds, unbroken, and is the *only good solid cast gun* out of the seven experimental columbiads cast in that manner.

"It should likewise be borne in mind that these results have been obtained under the most unfavorable circumstances for the hollow cast; the only experience in that mode of casting being that furnished in casting the experimental guns; while the solid mode has had the benefit of long experience in both Europe and this country, and the iron used in testing the experimental guns has always been with a view to making the best *solid cast* gun possible.

"The 32-pounders, and all but one of the 10-inch solid cast guns, have had the benefit, as far as it was possible to apply it, of the new mode of cooling, having been retarded in their rates of cooling by having fires burning in the pits while cooling, which is not the ordinary mode of cooling solid cast guns."

THE EXPANSIVE FORCE AND TEMPERATURE OF GUNPOWDER.

"Heat is everywhere present. Every body that exists contains it in quantity without known limit. The most inert and rude masses are pregnant with it. Whatever we see, hear, taste, smell or feel, is full of it. To its influence is due that endless variety of forms which are spread over and beautify the surface of the globe. Land, water, air, could not for a single instant exist as they do, in its absence; all would suddenly fall into one rude formless mass—solid and impenetrable. *The air of heaven, hardening into a crust would envelope the globe, and crush within an everlasting tomb all that it contains.* Heat is the parent and the nurse of the endless beauties of organization; the mineral, the vegetable, the animal kingdom are its offspring. Every natural structure is either immediately produc-

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ed by its agency, or maintained by its influence, or intimately dependent on it. Withdraw heat, and instantly all life, motion, form and beauty will cease to exist, and it may literally be said "Chaos is come again."—*Lardner.*

The effect of heat upon the metal of guns is the basis of my theory of the cause of failure of great guns. I claim that, as the gun is strained by the unequal communication of heat at the same time that the gun is subjected to the pressure of the powder, it is burst by the action of the two forces. With the theories of the various authors who have written on the subject of heat, I have nothing to do ; I only discuss its effects. Theorists have heretofore rather differed upon the question "What is heat?" than as to its effects. It is well established that when it is in contact with metals, it enters into combination with them, if they are not already supplied ; and when heat is communicated to metals their dimensions are enlarged, and most enlarged in that part to which the highest temperature is communicated. When heat is withdrawn irregularly from a mass of metal, the same effect takes place.

Too much pressure is attributed to gases of gunpowder, some authors fixing the pressure as high as 750,000 pound to the square inch of surface. Other estimates, however, vary to an extraordinary degree. Robins put it down as low as 1000 atmospheres, and Hutton at 1800 atmospheres, or 27,000 lbs. to the square inch. These men had no experience in bursting

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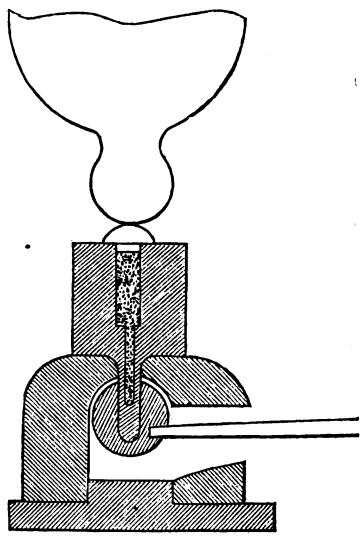
guns, but a long experience in firing guns of small sizes, and observing the *vis viva*, that is, the force *and time of force*, of gunpowder as communicated to shot.

Professor Treadwell speaking of Count Rumford's estimate (50,000 atmospheres,) says, "My own experience made in bursting *wrought iron* cannon, *the strength of which was known to me*, leads me to believe he has not over-estimated it, although I am aware that it is generally considered as excessive." Count Rumford arrived at his conclusions from firing powder in an eprouvette. In this experiment the knob of the cascabel of a heavy gun, weighing 8,081 lbs., was resting on a shot or piston keeping the bore closed. The powder in the eprouvette was ignited by the application of a heated shell to the hollow stem containing powder, so arranged that there was no escape of gases. Notwithstanding its great strength, the eprouvette was burst at the first fire into two pieces, and the weight was raised. From this he estimated that, as the tenacity of good iron is equal to resisting 4,231 times the pressure of the atmosphere on the same surface, as the surface of the fracture, and as the surface of the rup-



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ture was 13 times that of the bore, the force necessary to produce the rupture must have been 13 × 4,231 or 55,008 atmospheres. If there had been no pressure whatever from the gases evolved from the combustion of the powder, the sudden communication of a temperature higher than 2,700 degrees *the melting point for iron*, to the surface of the calibre, while the outside was not heated, or not heated until a later time, it would have been burst, parting with a shock that would have raised the gun weighing 8,081 lbs. If we discard this as evidence of a high expansive force from gunpowder, we may also discard Professor Treadwell's evidence that it was "not over-estimated" for the same reason, for his guns, "the strength of which was known to him," must have been similarly affected by the heat.

I have also had experience in bursting guns, the strength of which was known to me. I fired one slowly in the heat of summer, and did not burst it; I afterwards fired two of the same kind, having four times the strength of ordinary cast-iron guns, *rapidly*, in cold weather, and they burst. The inquiry why this happened, brought me to the conclusions herein exhibited, and this experiment cost $100,000, of which the government paid no part.

Besides the simple pressure of gunpowder, there are two other kinds of force exhibited, and they should not be confounded with each other, if we wish to arrive at just conclusions, viz.: *vis viva*, or living force,

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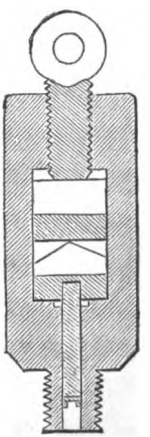
being the sum of result of pressure through space, or multiplied by time ; and if we are considering gun-powder pressure, the effects of the communication of a part of its high temperature to the surrounding metal of the gun.

All mediums, whether solids, liquids, or gases, when expanding by heat, exhibit force which exactly equals the force with which they would resist compression. The resistance to crushing in cast-iron or steel is about six times their tensile strength. This effect of *vis viva* and expansion by heat was not considered by Count Rumford or by those who have taken his experiments as the basis of their calculations. Captain Rodman and Colonel Bomford's experiments gave the *vis viva*, not the simple pressure, and were fallacious on that account. Colonel Bomford drilled holes at right angles to the bore, along the side of the gun ; in these he inserted small shots to be projected into a balistic pendulum, and from the recoil of the pendulum he estimated the pressure of the powder against the shot at different points along the bore, the same as in the experiments afterwards conducted by Captain Rodman with his instrument. The results of these experiments give similar pressures, but both were fallacious, for neither could tell how long the gases were in travelling along the holes, or with what velocity they moved, or,



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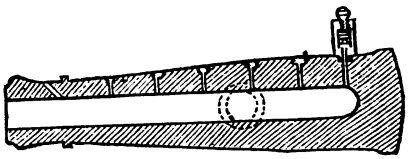

in other words, what amount of pressure had to be multiplied by time to give their results; or what divisor of time was to be used to divide the *time* from the *living force* to arrive at the true pressure of the powder. It is well known that a light weight falling through a greater space, equals in its impact a heavy weight falling through less space, and the consideration of this example is exactly analogous to the consideration of the experiments of Colonel Bomford and Captain Rodman.

The experiments of Guy Lussac, Dalton, Du Long and Petit, have established the fact that gases expand uniformly with increase of temperature, and it is also known that the expansive force of gases are doubled by an addition to their temperature of about 470° of Fahrenheit. This law holds whether the pressure be above or below the ordinary pressure of the atmosphere. When gases are said to dilate and contract by variations of temperature, it is necessary to notice the fact, that the process is different in gases from the process in liquids and solids.

When a solid or a liquid is cooled, the repulsive principle exhibited by the presence of heat being diminished, and the resistance to the attraction of cohesion being also diminished, the particles collect more closely together, the body, if a solid, occupying less space, with an exhibition of force that is exactly equal to

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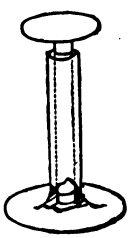
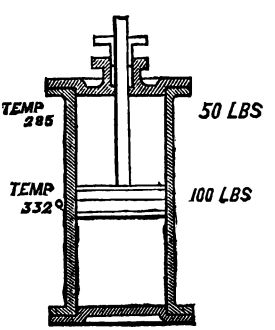
the tensile strength of the material. This does not happen in the same manner with gases. If a closed vessel be filled with gas and the temperature be lowered, the gas will still occupy all parts of the vessel, but at a reduced pressure. If the vessel should now be collapsed, by outside pressure, to the extent which would increase the pressure of the gas inside to the same pressure it had before the heat was withdrawn, the temperature would be raised to the same point again. A well known small instrument used for lighting tinder exhibits the effects of the mechanical evolution of heat by compression of air. When the cylinder is filled with common air, and the piston is entered and pressed down suddenly, sufficient heat is collected with the compression of the air to set on fire a piece of tinder attached to the end of the piston ; if put down too slowly the heat would be communicated to the walls of the cylinder. The air resists compression because of the heat: if the heat were withdrawn as the air is compressed, this piston would go down easier.



A steam cylinder having one cubic foot of capacity above and below the piston, if filled with steam at 100 lbs. pressure would have a temperature of 332° ; if the piston was raised until the pressure was reduced to 50



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lbs., the temperature would also be reduced; if the piston should then be pressed downwards again until the pressure returned to 100 lbs. the temperature would return to 332.

If we wish to change a gas into a liquid, we must first subject it to compression by mechanical force, then reduce the temperature by frigorific preparations, then repeat the mechanical compression and the reduction of temperature again, as often as required, to obtain the result. When the liquid state is obtained, the continuation of the reduction of temperature produces the solid state. The reversal of this process will resolve a solid into a gas. THE EXPANSIVE FORCE OF ALL GASES, THEN, IS DUE TO HEAT.

In 102 parts by weight of nitre there are—

1 equivalent	of potassium	40	by weight
1 "	of nitrogen	14	" "
1 "	of oxygen	48	" "

One equivalent of potassium will require one of sulphur to unite with it, to form sulphide of potassium. Six equivalents of oxygen will require three of carbon to form carbonic acid gas. Whence there is necessary for the formation of gunpowder—

1 equivalent	of nitre	102	by weight.
3 "	of carbon	18	" "
1 "	of sulphur	16	" "
		136	

And the result of combustion will be—

1 equivalent	of sulphide of potassium	56	by weight.
3 "	of carbonic acid gas	66	" "
1 "	of nitrogen	14	" "

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56 pounds or 900 ounces contains—

93 ounces	. . .	nitrogen	} Gas.
437 "	. . .	carbonic acid	
370 "	. . .	sulphide of potassium.	Solid.

Equal to 43 parts solid, and

" to 57 " gas.

The specific gravity of air being . . . 1

" " "	of nitrogen is . .	1.1738
" " "	of carbonic acid gas .	1.8440

And as 1 cubic foot of air is . . . I ounce,

1 cubic foot of nitrogen weighs . .	-	1.1738
1 " " of carbonic acid weighs .		1.8440
1 " " of sulphide of potassium "		865.0000

Having these proportions, we may estimate the quantity of gas in cubic feet that results from the combustion of one cubic foot of gunpowder, the weight of which is about 56 pounds, as follows:

93 ounces	of nitrogen is . . .	79.00 cubic feet.
437 "	of carbonic acid . .	337.00 " "
370 "	of sulphide of potassium	0.43 " "
900		416.43

The result then is, 416 feet of gas resulting from the combustion of one cubic foot of gunpowder, and this gas has been expanded from $\frac{57}{100}$ of a cubic foot of space; for $\frac{43}{100}$ of the result of combustion, is sulphide of potassium, a solid. If this cubic foot of powder had been burned in a gun of $13\frac{1}{2}$ inches diameter of bore, of which the length was more than 832 feet, it would occupy one foot of its length; if there were no heat lost by being communicated to the walls of the gun, and no loss of force by friction or escape by windage,

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a shot would be forced along the bore 832 feet, at which point it would stop, and then recede, nearly to the bottom of the bore again, because there would be a partial vacuum behind it. After a few oscillations it would come to a rest at a point 416 feet from the bottom of the bore. If the motion of the shot was resisted by a force that was exactly equal to the expansive force of the powder, but permitted to move slowly forward, when it was 416 feet from the bottom of the bore it would come to a state of rest. But if not resisted, it would strike its hardest blow at the distance of 416 feet from the bottom, and this blow would be an exhibition of the living force of the powder. If the shot should then suddenly be pressed back to its original position, the expansive force of the gases and their temperature would be exactly the same as if the powder had been fired in a closed space of one cubic foot capacity, provided there was no escape of any part of the gases by windage or vent, and no part of the heat was communicated to the surrounding metal of the gun or shot.* If a spherical receiver were provided of 416 feet capacity, from which the air was exhausted upon firing a cubic foot of powder in the centre, the gases would expand and be projected against the walls with considerable force and after a few vibra-

* I find the opinion holds with many, that in estimating the expansive force of the gases, as in this example, additional pressure should be added for the increased temperature evolved by compression. This is like expecting two sufficient effects from one cause, and, in my opinion, is the result of attributing to heat the effect of the *time* the force acts.

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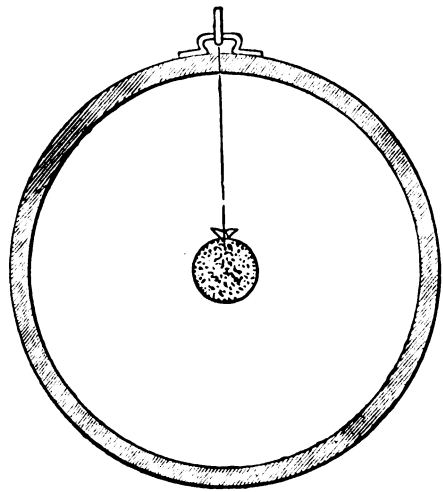

tions they would come to a state of rest at the pressure and temperature of the atmosphere. The heat would be reduced as the gases were expanded, to occupy more space as in the example of the steam cylinder. If the gases were compressed back into the cubic foot of a space, the pressure and temperature would be raised to the same extent as if the powder had been burned in a cubic foot of *closed* space ; the temperature would be raised in the same manner as in the example with the instrument for lighting tinder. This is one of the curious examples by which we can arrive more nearly at the truth, by theory, than we can by experiment, as it is practically impossible to so conduct the experiment as to permit no escape of heat or gases while conducting it. As the 416 cubic feet of gases have been expanded from $\frac{57}{100}$ of a cubic foot of space, in estimating their expansive force we must consider them to be recompressed into $\frac{57}{100}$ of a cubic foot of space. The pressure then would be about equal to 743 atmospheres, or about 11,145 lbs upon the square inch, and a temperature about 5,000°. In a gun, however,

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this high pressure and temperature is never obtained, because a part of the gases escape by the vent and by the windage, and a part of the heat, and consequently the expansive force is lost from the communication of part of the heat to the metal of the gun and the shot.

The powder is not instantly burned; while the process of combustion is going on, *the shot moves* by the pressure evolved, reducing the pressure and temperature by increasing the space behind it in which the gases are confined. The pressure is also less than the full pressure, in the proportion to which the shot gives way to motion with less than the full pressure of the gases, supposing the pressure was completely resisted on all sides. It is probable, therefore, that the pressure in a gun, with but one shot, is not more than 8,000 lbs to the square inch; but it is greater when the bore is filled with balls. In Major Wade's report, page 15, is a table of charges used in extreme proof of four 6-pdr. guns. One of these guns endured 14 charges with 3 lb. of powder and 16 balls, and two charges with 6 lbs. of powder and 7 balls, without bursting. *This gun was afterwards burst with* 20,000 *lbs. hydraulic pressure* on the square inch. This example is far from corroborating the theory of Hutton, that the pressure of powder is 27,000 lbs.; of Rodman, that it is 200,000 lbs.; or of Count Rumford, that it is 750,000 lbs.; or of Professor Treadwell, that Count Rumford had not over-estimated it. Other guns have been burst with a hydraulic pressure of less

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than 10,000 lbs. on the square inch, after they had endured full charges of powder with shot. Heat expands gases of gunpowder to 743 times their first capacity for 5,000°. Iron is expanded $\frac{1}{80}$ part of its length only for an application of about $\frac{1}{4}$ of that high temperature. The effect of heat is resolved into motion or pressure, (partly of both,) as it is communicated to solids or to gases. When communicated to gases it is resolved principally into motion. When to solids, chiefly into pressure; but the sum of its effects, in each case, is equal—as high pressure with slight motion, can, by levers, be changed into considerable motion with light pressure; so also can considerable motion by the same means be changed into high pressure with slight motion. The effect of heat, then, when communicated to one part of the metal of a gun before it is communicated to other parts, is to expand that part with a force that is greater than the pressure of the gases, in the proportion that the distance it expands metals is less than it expands gases. If the shot were fixed in a gun so as to entirely prevent the escape of the gas long enough, the metal nearest the powder would receive a temperature that would be a mean between the temperature of the powder and the metal of the gun, proportioned to the mass of each. The expansion of the inner metal would with certainty burst it, as in the example of bursting the eprouvette at the first fire, in the experiment of Count Rumford, and in the experiment of Rodman, described on page

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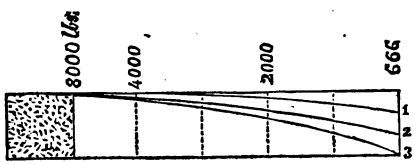
205 of his profound work. Every moulder employed in an iron foundry is aware of the necessity for having his castings cooled uniformly, and when he notices a casting he is making has much greater thickness in one part than another, he knows the necessity of taking steps to cool the heavier part with water, else it will be broken when it is finally all cooled.

To attain comparative safety in the larger guns lately made for our government, a coarse or pressed powder has been invented and adopted, especially for the 15-inch gun. It certainly is pretty easy upon the gun, just as slow burning fuel would be easy upon a steam boiler, but it does not give the required velocity to the shot. As if to deceive even themselves, ordnance officers have given it the name of *accelerating*, probably as a certain room in a theatre is called a green-room "because it is not green."

The following diagram exhibits the pressure of powder at points along the bore, supposing the whole of the powder to have been burned before the shot had moved: granting the position, that the pressure of the gas is 8,000 pounds against the shot, as I have previously shown.



When the shot has moved forward to the point that doubles the space behind it, the pressure would be 4,000 lbs. If only half the powder had burned at this time, the gases would have been ex-

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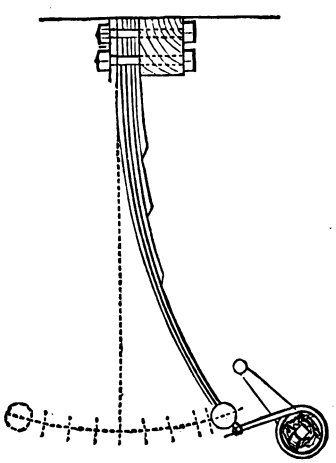
panded into three times their first space, in which case the pressure at that point would be 2,666 lbs. If the remaining half of the powder should then be instantly burned while the shot was passing that point, the pressure would be raised to 4,000 lbs., but, as a part of the *time* this pressure would have acted to accelerate the shot has been expended, its effect towards accelerating the shot would be less, as 2,666 is to 4,000. The quickest burning powder, then, is the accelerating powder. When the shot has moved to the fourth point on the diagram, the pressure of the gases is reduced to 2,000, and at the sixth point to 666 lbs. Yet, at this point where the pressure is so low, the shot has its highest velocity, and here it would strike the hardest blow, as with the spring pendulum. If, after being drawn to one side, the pendulum was let go suddenly, it would strike the hardest blow at the centre, at the exact point where, if it was eased down, it would come to a state of rest without pressure or motion—the pull upon the cord that holds it to one side, is the measure of its pressure at that point.



The force with which it would strike the blow at the centre, if let go suddenly from one side, is called *vis viva*, or living force.

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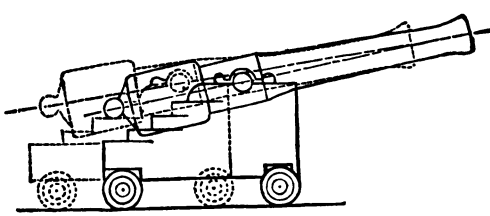
It should be remembered, that the gases of gunpowder always have the same weight as the powder

from which they have been evolved. A musket barrel is burst at the muzzle if the shot is carelessly inserted, and not put down against the powder, by the momentum, or *vis viva* of the gases, that, having weight and velocity, are projected against the bullet.



When a long rifled cannon is fired at a high elevation, the gun recoils backward on a plane, represented by the deck of a ship, different from the plane of the bore. All bodies in motion resist a change of direction, in the proportion of 1–90th of their whole momentum, or living force, for a change of direction of 1°. If one billiard ball on a table, is projected against another at rest, striking it at right angles 90°, the one in motion comes to a state of rest, giving its whole momentum off, to the one before at rest. If the one at rest should be struck at an angle of 45°, the ball in motion would have its direction changed 45° and it would give one-half its momentum to the other. Each would roll the same distance on the table. So, also, if the angle with which they came in contact was one degree, 1–90th of the momentum

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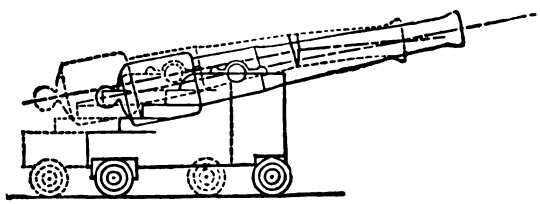
would be given to the ball at rest. The whole sum of the momentum of a shot projected from a rifle cannon, is very great. At the muzzle of the gun, the resistance to a change of direction is sufficient to overcome the preponderance of the gun. If the bore was crooked, the shot would not be much diverted, but the gun would be moved to conform to the direction of the shot, and many have noticed, when firing guns on ship-carriages, at high elevation, that the breech of the gun was raised, and came down again with a considerable blow on the quoin, or elevating screw. If the chase of the gun is light, the muzzle will some-



times be broken off, instead of overcoming the inertia of the gun, or lifting the breech suddenly, against the resistance of the preponderance. This example is inserted as one of the peculiarities of living force, as exhibited in gunnery, viz.: resistance to changes of direction by bodies in motion, and to account for the failure of many of the Dahlgren and Parrott guns, from the breaking off of their muzzles, as has frequently happened to the Parrott rifle guns, and to the Dahlgren guns since the war began.

"About 1845, Colonel Bomford devised a plan for

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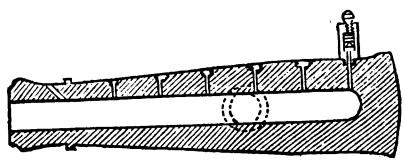
determining the *pressure* at various points of the bore by direct experiment. It essentially consists in boring a series of small holes, through the side of the gun, at right angles to its axis. The first hole being placed at the seat of the charge, and the others at intervals of one calibre. A steel ball was projected from each hole in succession, by the force of the charge acting through it, and the *pressure* at the various points, were deduced from the velocities communicated to the balls, this plan has been lately tried in Prussia with great success."—*Benton.* *If a musket barrel had been inserted in each of these holes,* to increase the length of the tube and the *time* of the pressure from the powder acting against the steel balls, the velocity would have been greater, *and the increased velocity would have been evidence, not of greater pressure, but of longer time of the action of the force.* Rodman's experiments were similar to this, so, when he was endeavoring to determine the difference in pressure of the powder when fired in guns of various sizes, his conclusions were fallacious, as the three guns, 7-inch, 9-inch, and 11-inch, each had a proportionate thickness of wall, and, consequently, a longer tube or bore through which the gases were projected. The result is exhibited in the following table of, so-called, pressures obtained from *Rodman's Book, page* 197 :



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HOW LIVING FORCE IS ESTIMATED TO BE PRESSURE.

"Table showing the velocity of shot in feet per second, and pressure of gas per square inch in pounds, due to equal columns of powder behind equal columns of metal, when fired in guns of different diameters of bore, each result being a mean of ten fires."

Diameter of bore.	Windage	Weight of Charge.	Weight of Shot.	Velocity.	PRESSURE AT DIFFERENT DISTANCES FROM BOTTOM OF BORE.						
					At bottom	At 14 in	At 28 in.	At 42 in.	At 56 in.	At 70 in.	At 84 in.
		lbs.	lbs.								
7 in.	0 7	513	7444	904	36420	15850	8370	6470	6850	8050	6720
9 "	0 9	848	12442	888	67100	21100	17750	14900	29475	20970	22825
11 "	011	1267	18603	927	86750	27300	27800	22420	28400	33850	25050

The sum of the whole pressure in the 7-inch gun is, 88,730 ; mean, 12,675.

The 9-inch gun—whole pressure, 194,120 ; mean, 27,731. More than double the pressure of the 7-inch gun.

Whole pressure in 11-inch gun, 253,570 ; mean, 36,224—three times the mean pressure of the 7-inch gun, yet the velocity is about the same. If pressure of the powder gives the motion to the shot, why is the velocity in the 11-inch gun, the same as the velocity of the 7-inch? It would seem that any man of ordinary capacity, would have drawn other conclusions from a careful consideration of the results of these experiments, than those drawn by Captain Rodman. He says: "The cause of difference in *pressure* in these guns of different diameters of bore, is believed to be mainly due to the greater heat developed by the combustion of the larger mass of powder in the large, than in the small, calibre."

He also says: "One of the points most worthy of note is, that the indications of pressure are greater at

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56 inches, 70 inches, and 84 inches, than at 42 inches, especially in the 9-inch and 11-inch guns."

The solution of all this is, in the theory, that the instrument exhibits the effect of living force, the same as the result obtained by Colonel Bomford and by the Prussian officers, and the theory illustrated by billiard balls on a preceding page.

On page 176 of Rodman's book, devoted throughout to special pleading for a manner of casting guns invented and patented by himself, and for a kind of slow burning cake, similar to fuse-powder, that made even comparative endurance in such guns possible, is a table of "*Pressure of gas at different points along the bore.*"

For the purpose of determining the pressure at different distances from the bottom of the bore, two series were fired, one with 10 lbs. of *grained* powder, and the other with 13 lbs. of the so-called Rodman's accelerating cartridges ; same weight of shot and sabot in both series, and charges accurately weighed ; powder for grained cartridges having been mixed :

Number of Fires.		Distance from bottom of bore.	Pressure per Inch.	
Accelerating.	Grained.		Accelerating.	Grained.
3	3	At bottom.	10989	41287
3	3	2 Calibre.	26001	57512
3	3	4 "	12457	14103
3	3	6 "	8620	10878
3	3	8 "	5801	10417
3	3	10 "	4870	7127
3	3	12 "	4071	8932
3	3	14 "	4071	9007
Sum of the Whole Pressure....			74890	159255
Mean.....			9360	19966

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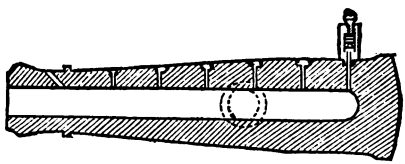
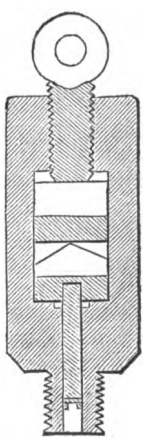
Here is a fine example of acceleration—a mean pressure of 9,360 lbs, for 13 lbs. of cake powder; and a mean of 19,966 lbs. for 10 lbs. only, of fine powder.

The following diagram represents the gun as prepared for the instrument.* Where the metal is thickest, and, consequently, the tube longest, the pressure is highest; and at 12 calibres near



Description of Rodman's Testing Instrument, from Professor Treadwell's Letter "On the Construction of Improved Ordnance."

"This instrument, and its use, will be understood by any engineer or intelligent mechanic from the following description: Suppose a row of six 'small holes to be drilled through the side of a cannon into its calibre. These holes are placed 14 inches apart, and, commencing near the breech, extend to near the muzzle, or a distance of 84 inches. The instrument consists of a small but strong iron frame, having a shank or plug forged upon one of its sides. This plug is 1½ inches in diameter, and 1½ inches long, and is formed into a screw, the thread of which corresponds with a similar screw thread cut into the outer portion of each of the holes in the side of the gun, by which means the same may be secured to either of the holes at pleasure. A small hole is bored through the axis of this plug, making a free passage to the calibre of the gun. A piston is nicely fitted to this hole in the plug, and the end of the piston receiving the whole force of the fired gun powder will be driven outward at each dicsharge. A large steel head or block is fitted upon the outer end of the piston, and from the head rises a pyramidal or lozenged shaped point or blunt edge. Against this edge, and firmly fixed in its frame, is a piece of thick copper. Now when the gun is fired, the piston, being drawn outward, forces the dull point or edge into the copper, and leaves a mark or impression upon it corresponding in depth to the force in which the piston was driven against it. By comparing an impression made this way with another impression made upon another piece of copper, by the actual pressure of weights placed upon a similar tool, Captain Rodman supposes that the force of the piston may be estimated very nearly. The reader will perceive, on reading a little further in the text, that the force of the point, by which the



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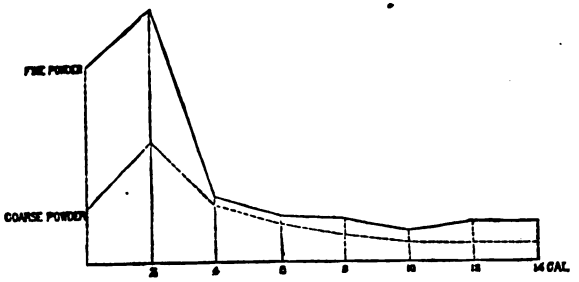
the muzzle, where the hole is inclined, the pressure is somewhat higher than at 10 calibres.



It would be more proper to call the 13 lbs. of powder accelerating, if the line representing it, had crossed the other, and given a larger area of pressure along the chase, to compensate for the low pressure along the re-enforce. Its principal merit is, that it does not strain the gun, but then the fine powder would be easy on the gun, if it was adulterated with half its weight of ashes or sand. With the knowledge that action and re-action are equal, it is difficult to believe that the pressure could have been greater, at two calibres, than at the bottom. The living force might have been greater, because the tube was longer, or the distance to the instrument was greater, or the time the gases expanded in reaching the instrument, was greater. The simple pressure of the powder, could not have

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impression is made by the instrument is not the equivalent of the pressure upon the calibre of the gun, and that it was a gross oversight in Captain Rodman to consider them as equals. It will, of course, be understood that when one of the holes is used by the instrument, the others are closed by screw plugs made to fit them."

[*His description is complete except that it does not mention the important fact, that the* HOLE *nearest the muzzle* WAS INCLINED, *as seen in the sectional diagram of the gun.*]—ED.

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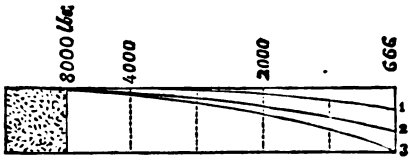
been greater in any part of the bore, than at the bottom, although it might have been less ; gases having weight and motion, consequently *direction*, are inclined to keep their direction and resist a change as previously shown.

The diagram repeated here has three curved lines, marked 1, 2, 3. No. 1 represents the loss of heat from the gases, as they are exposed to increased surface of the colder bore of the gun and projectile. Loss of heat involves loss of expansive force, and at the muzzle of the gun, where the gases have expanded to six times the space they occupied as powder, the expansive force is reduced to 666 lbs. on the square inch. I think a deduction should be made of one-third of this pressure, for the heat communicated to the surface of the bore. While the shot is at rest against the powder it has no friction, but, as it increases in velocity, the friction increases to the extent that would justify another reduction of one-third from the 666 lbs. for this resistance, as shown by curved line No. 2. Then, before the shot has received motion, the pressure of the atmosphere against it, on both sides, is equal, but as it is forced along the bore, the pressure and inertia of the atmosphere, retard sufficiently to consume the remainder of the 666 lbs. of pressure, line No. 3. Extended experiments have been made, to de-



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termine the proper length of bore of guns, but since the experiments of Hutton, nearly one hundred years since, but little attention has been paid to the length of the cartridge. If the length of the cartridge were always given, it would be easy to decide upon a proper length for a gun; a measure of length of bore by calibres has become, however, established. In designing a gun the length of the cartridge should be fixed first, then the length of bore should be between four and a half and six times the length of the cartridge. If a gun is too long the shot will be retarded by the reduction of expansive force due to loss of heat, to the increased cooling surface to which the gases are exposed; to increased resistances due to friction and to resistance of atmosphere, through the surplus length of the bore. I propose for these reasons, that hereafter, the length of bore of guns shall be given in *cartridges* instead of *calibres*, as the standard for measures of the length of guns.

Before concluding this portion of my subject, I will sum up the results of the preceding arguments:

I have shown, That writers on ordnance and ordnance officers, have fallen into the glaring error of attributing the bursting of great guns to the expansive force, and corresponding pressure of gunpowder alone; altogether ignoring the presence of heat, as a bursting agent.

I have shown, The fallaciousness of the arguments

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brought forward to sustain their theory, by exposing the discrepancies of their calculations as to the amount of pressure, which varies in several received authorities, from 15,000 to 750,000 lbs. pressure to the square inch. Showing, in the course of my argument, that guns which had withstood that, supposed, enormous pressure, (taking either extreme estimate,) were afterwards burst by hydraulic pressure, 10,000 lbs. to the square inch.

I have shown, The utter inefficiency of their instruments to enable them to arrive at a just calculation of the pressure evolved, even though the theory of living force, *vis viva*, is ignored.

I have shown, By copious extracts from the official reports, published and rendered to our government, by ordnance officers, that the cause of the bursting of great guns is, to them, an unfathomed mystery, which deepens with every successive failure in their experimental trials.

I have shown, That writers on ordnance and ordnance officers, have no knowledge of the materials, from which safe guns could be made, as the average of failures of solid cast-iron, hollow cast-iron and wrought-iron guns, is pretty nearly equal; and that neither of them can be relied upon as a safe material or method for large guns, and by this, I have proved that the whole basis of the present system of construction is wrong.

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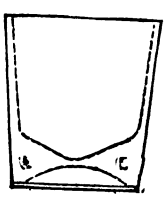
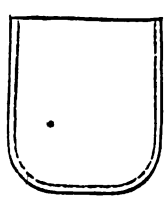
I have shown, By my theory of heat, which establishes that element as a prominent agent in the bursting of great guns, that only by a *combination of metals, or devices for increasing the elasticity of any single metal,* can a *compensation* be obtained and *bursting be surely prevented,* both of which conditions I have made provision for and have hereinafter fully described.

HOW GUNS BURST.

When gunpowder is fired from a gun, two prominent phenomena are to be observed; the wonderful expansive force which ejects the shot, and the heat which results from the combustion of the powder.

Let us exhibit the effect of heat on metals by a familiar experiment. Pour boiling water into a glass tumbler; the heat, communicating more quickly to the thin sides than to the thick bottom, breaks the glass from unequal expansion. If we wish the tumbler to withstand the sudden communication of heat, we must make it everywhere thin alike, so that the heat may pass through it uniformly and quickly. Hot water may then be poured into it with impunity. But if we wish it to withstand a pressure of cold fluid, it will be necessary to make the walls equally thick; it





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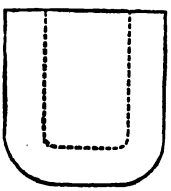
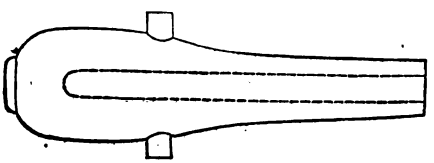


will then withstand a considerable pressure on its interior surface, even if communicated suddenly. But if, after having prepared it to withstand the pressure, we wish to communicate a pressure accompanied by heat, as of a considerable height of column of melted metal, although the thickness of the walls would be sufficient to withstand the pressure, the heat communicated to the inner surface of the wall would expand it within the outer metal, before the heat reaches the outside, and it would be broken by this unequal communication of the heat. Now, this unequal communication of heat, has a similar effect upon large guns. This may, also, be illustrated by a glass model of a gun, which, although strong enough to withstand a pressure on the inner surface of 400 pounds to the inch, would be broken by the insertion of a heated rod of iron of smaller diameter than the bore, even though so inserted, as not to come in contact with its sides, and not accompanied by any pressure against the surface. Three models might thus be broken quickly, in succession, by the insertion of an iron rod heated to a high temperature, while the fourth would break slowly, or not at all, the rod being reduced in temperature, from the heat lost by communication to the broken models. If, however, after



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waiting a time *for the model to be slowly heated throughout its whole mass*, the outer surface of the gun be touched by the wetted finger, the evaporation of the moisture will make the heat sufficiently unequal, and the model will break. This example may exhibit the direct cause of the bursting of the 100-pdr. Parrott gun, on the steamer Naugatuck, on the James River, before Fort Darling, when other guns of the same kind on the steamer Galena, though fired with great rapidity, and oftener, did not burst; all of which may be accounted for, by the fact that it was raining at the time, and that the gun of the Naugatuck being on the upper deck and exposed to the rain, was subjected to a more unequal heating, than the guns of the Galena, which were between decks. I have stated that guns are more *likely to burst* when fired on *cold* or *rainy* days, and offer the following examples in corroboration: first, two large steel guns, of my fabrication, burst under such circumstances, then this example of the gun on the Naugatuck, and two guns referred to in the Table on opposite page, are among many other similar cases I have noticed.

There being two forces acting upon the guns which burst, one the direct pressure of the gases evolved from the powder, and the other resulting from the expansion of the inner metal of the gun, both forces acting in the same direction, and nearly at the same time, it would seem difficult to show one to be pre-eminently the cause of the fracture. It being remembered that

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Meteorological Observations, and Number of Rounds fired each Day. A table from Rodman's Book, showing that Guns burst on Cold and Rainy Days. Diagrams of Fractures of Guns No. 335 and 983 can be seen on pages 69 and 70, Rodman's Book.

Days of the Month.	TEMPERATURE. Thermometer. 7 A. M.	2 P. M.	9 P. M.	Mean.	WEATHER.	Number of Charges Fired each Day. 334	335	983
Oct. 22,	33°	51°	43°	42.33°	Cloudy; fog at 7 A. M.	Proof 2d.	Proof 2d	Proof 2d.
" 27,	43	45	42	43.33	Cloudy; atmosphere hazy.	12	12	12
" 28,	40	45	42	42.33	Cloudy; atmosphere hazy.	14	14	14
" 29,	41	45	43	43	Cloudy; atmosphere hazy.	20	20	20
" 30,	40	45	41	42	Cloudy; atmosphere hazy.	20	20	20
" 31,	42	50	38	43.33	Fair.	20	20	20
Nov. 2,	46	54	46	48.66	Fair.	20	20	20
" 3,	43	50	35	42.66	Fair; atmosphere hazy.	25	25	25
" 4,	33	55	40	42.66	Showery	25	25	25
" **5,**	**41**	**59**	**58**	**52.66**	**Showery**	**32**	**32**	**11**
" 7,	56	77	65	66	Fair.	20	20	
" 11,	32	45	35	37	Cloudy; shower at 4 P. M.	31	31	
" 12,	32	51	46	43	Cleared up at 11 A. M.	31	31	
" 13,	43	48	36	42.33	Occasional sprinkle of snow.	32	32	
" 14,	38	36	29	34.33	Occasional sprinkle of snow.	32	32	
" 16,	33	41	45	39.66	Rain and sleet.	32	32	
" **17,**	**39**	**42**	**40**	**40.33**	**Cold Rain**	**33**	**31**	
" 18,	41	45	41	42.33	Occasional sprinkling of rain	56	Gun	
" 19,	46	32	27	35	Rain and snow	8	Burst.	
" 25,	16	23	16	17.66	Fair	64		

——Gun Burst.——

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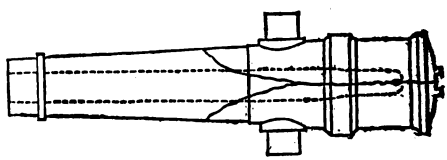
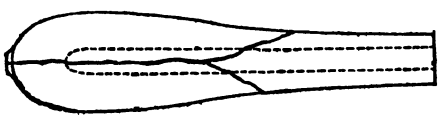
the living force is not expended on the gun, except when the cartridge is too small in diameter, or when the shot is not *home*, as in the example of the musket-barrel.

The fractures of large guns upon improved models, with a light chase and heavy re-enforce, that have burst with the service charges, are curiously alike in their direction, running through the centre of the breech and re-enforce, to a point usually forward of the trunnions, and branching off at either side, generally breaking the gun into three great pieces. This direction of fracture holds whether the gun has the outlines of the army columbiad, of the Dahlgren gun, or of the Parrott gun with its strong wrought-iron re-enforce, and whether the gun be made of steel or of cast-iron. It would scarcely be expected, when the Dahlgren guns burst, with this great thickness of metal about the breech, that the fracture would occur through the cascabel, where the metal has more than twice the thickness exhibited in the army columbiad, but this principal direction is usually the result.





Guns sometimes exhibit additional fractures to those represented above, and this occurs when the thickness of metal is continued further forward towards the

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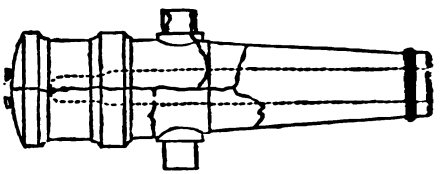
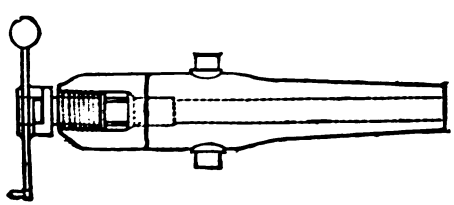
muzzle, having the same effect as if a tire, or strong band, were placed upon the gun at the place where the fracture usually branches off to either side, thus delaying the longitudinal fracture until the expansion lengthwise of the inner metal is greater than the *elasticity* and *ductility* of the re-enforce, when the cross fracture occurs. It may be said then, in brief, that the fractures at right angles to the plane of the bore are caused by the lengthening of the inner metal about the bore by heat, while the outer metal remains the same length, or with less expansion of length, until ruptured, and that longitudinal fractures are due *principally* to the enlargement of the inner metal *by heat* in the direction of the diameter, or *radially*. If the gun be parallel all the way to the muzzle the cross fractures will occur more frequently along the re-enforce, because in that part it is exposed to the highest temperature, and, consequently, the greatest expansion of length. I have seen a diagram of an Armstrong gun with only one fracture. In this gun a die is pressed with a powerful screw against the inner metal of the gun, and against the bottom of the bore. A heavy weight on the crank





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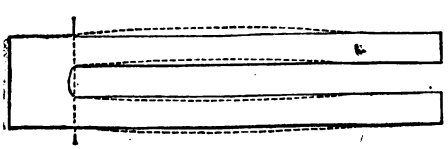
is used, by repeated blows, to press forward the die by the screw with considerable force. The screw and die were made of steel with little compressibility, and the lengthwise expansion of the inner metal of the gun, would increase the tension upon the re-enforce, *already great from the pressure of the screw*, to bursting. Greater thickness of metal, at either end of the re-enforce, would make the cross fracture more frequent. It is a corroboration of this theory that the guns of the Dahlgren model, with more than double the thickness of metal behind the chamber, though made of the strongest material, should break in the same direction, forward of the trunnions, but sometimes exhibit only cross fractures (when made of cast iron) to the rear of the trunnions. It is evident that the model is best in which the direction of the fracture is least uniform, but a properly constructed gun should not burst at all.

The gun, however, is usually broken through the breech—the strongest part of the gun—and beyond the range of the pressure, which is, of course, limited to the bottom of the bore or chamber. The diagram



in Capt. Rodman's book, p. 43, exhibiting the various kinds of strain to which a gun is subjected at each discharge, considers the gun as if made up of staves, and really exhibits only the strain from the expansive force or direct pres-

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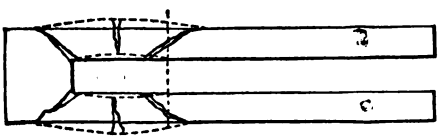
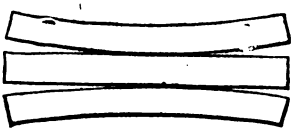
sure of the powder, bending the staves outward ; and

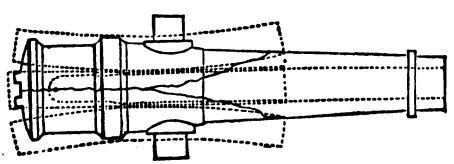


page 47 of the same book, by diagram, the direction of fracture due to such strain, not through the breech, but running at an angle to the plane of the bore.

To show that it is improbable that the direct pressure of the powder should be the cause of fracture, as exhibited by the gun actually broken by firing, prepare three plates of metal, say 4 inches thick, 12 inches wide, and 60 inches long, with plane surfaces ; the mid-



dle one, on being heated to 1,600°, will be found expanded one-sixtieth part of its length, or will be 61 inches long. On placing it between the other two, a part of its heat is immediately communicated to their contiguous surfaces only. The expansion of one surface of the outside plates, while the other surfaces remain cold, warps the latter to the form of a segment of a circle. Now, supposing them placed upon the diagram of a burst gun, the centre metal of which has been



heated by the combustion of powder, it is evident that the fracture in the particular direction exhibited must have resulted from the unequal expansion of the gun by heat, and a dia-

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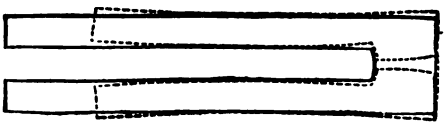
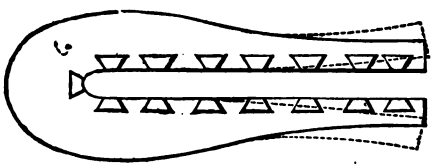
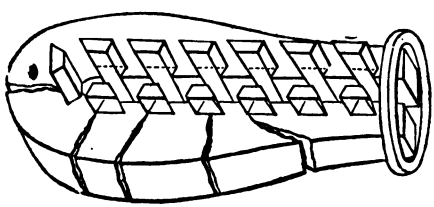
gram exhibiting these curves, the result of this expansion, will be exactly the opposite of the curves on the diagram by Rodman, and will account for the breaking of the gun through the breech, beyond the range of the pressure made by the powder.



The following diagrams exhibit the effects of expansion of the inner metal by wedges, the drawing exhibits a section of the metal of a gun, with dovetail notches cut along the surface of the bore. Upon driving wedges into the notches the muzzle would be expanded, as shown by the dotted lines. If a band were put upon the muzzle, the fracture nearest the muzzle and the one through the cascabel would be most likely to occur first. If the band were placed over the first mentioned fracture, and the wedges along the re-enforce and at the bottom of the bore driven most, as the heat is most intense at the bottom of the bore, cross fractures of the re-enforce would be the result, as shown in the diagram. As the heat expands the metal in the direction of the diameter also, its effect in this direction





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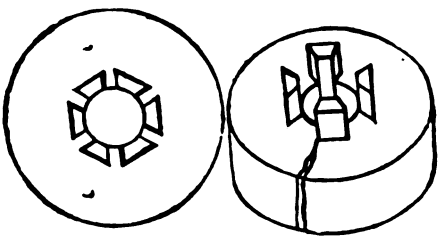

also must be considered. The expansion of length, however, is of most consequence in considering the probable direction of fracture.

That the fracture almost always intersects the vent has been heretofore referred to the weakness resulting from drilling away part of the metal, but on page 355, Major Wade's Reports on Metals for Guns, we find that after a gun had been put to extreme proof, and exhibited signs of fracture, a hole was drilled one inch forward of the base ring, and four inches from the line of the vent, to a depth of four inches, and of the diameter of one and a quarter inches. The gun was then fired with double charges of powder, and with a bore full of balls and wads, eleven times, to bursting. Although the piece burst into more than twelve fragments, one of the fractures intersecting the vent, it did not split through the large hole, showing that the gun had strength to resist the pressure of the powder, but burst, notwithstanding the drilling away of so large a part of the metal, from the communication of heat. The true cause, probably, of the intersection of the vent by the fracture, was the communication of heat to the surface of the vent, thereby expanding a column of metal about it, for it should be recollected that the passage of a large quantity of gases through

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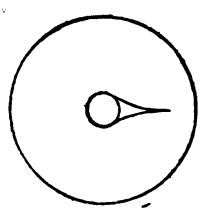
the vent would communicate more heat to its surface than would be communicated if there was no current, but the capacity of the vent only filled; in that case not much heat would be supplied to the surface, because the quantity contained within the vent would be small.

But in this example, as in all others, as is well known to ordnance inspectors, the fracture began to exhibit itself on the interior surface of the bore. This would seem to prove that guns burst by pressure rather than by expansion of the inner metal—as if the inner metal were expanded by the communication of heat before the outer metal gave way—*a strain of compression* resisted by the strength of the outer metal would rest upon the inner metal of the gun that would prevent fracture; and, undoubtedly, if it ever occurred to an ordnance officer to inquire whether the communication of heat to the inner metal of guns was the cause of their failure, the beginning of fracture on the inside would appear to him an argument against the theory. This I consider a critical point, but one directly favoring the theory. It requires a most familiar knowledge of the effects of heat, and a careful recollection of time and place of all the phenomena, to comprehend and explain this part of the subject. The accompanying diagram exhibits a cross section of a gun at the point of greatest pressure, and, consequently, highest



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temperature ; the surface of the bore is supposed, in this example, to be *continuously* exposed to the high temperature evolved from the combustion of powder when its expansive force is resisted by the inertia of a heavy projectile, or, *as if a fire were constantly burning within the gun.* The space *between the curved lines* represents the place and quantity of heat thus communicated to the metal, showing the greatest expansion immediately at the surface of the bore.* But we are to recollect that, in the most rapid firing, the surface of the bore is exposed to this high temperature only about one hundredth part of the time, while during the other ninety-nine hundredths the heat of the surface of the bore is radiating away. If the diagram represented a gun of six inches diameter of bore, and eight inches thickness of metal about the bore, the range to which the heat would penetrate the metal at the first discharge would be about four inches ; for heat enters metal with a velocity depending on the difference in temperature of the source from which it flows and the metal into which it is flowing. The heat is communicated to the *small* surface of the bore, while it is radiated from the *large* outside surface of the gun ; from this cause, if from no other, the temperature would be much higher within the mass than on the outside.

* To represent a reduction of temperature by lines converging toward each other I know is not philosophical, although as no conventional lines have been adopted to represent intensity of heat by their direction, and as I have confidence, my meaning will be understood. I have chosen to use them in this manner.

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The penetration from the first discharge being four inches, it might be supposed that the range of the heat from the next discharge would be greater; but heat having been communicated by the first discharge, the range of the second is less, from the reduced difference of temperature. Although, of course, the heat flows onward, its motion is very slow. If, then, the penetration be four inches, at the distance of four inches from the surface of the bore the temperature will be comparatively low, but little higher than that of the metal at four and a half inches from the surface of the bore. The heat, therefore, is conducted from the point of four to that of four and a half inches slowly; more slowly from that of four and a half to five, and with a continually reduced and very slow rate of motion to the outside. As the heat is communicated from one inner stratum to the stratum surrounding it, for each inch of the increasing distance it travels, the mass of which the temperature has to be raised is greater in circumference also; this is another cause of the retardation to its motion outward. Although for ninety-nine hundredths of the whole time the heat is radiating from the surface of the bore, the velocity with which it leaves is much less than the velocity with which it is received, because the difference in the temperature of the gun and the atmosphere occupying the bore is much less than the difference of temperature between the metal of the gun and the gases ejecting the shot by their pressure. The atmosphere

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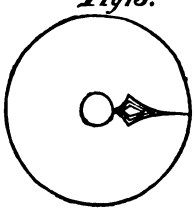
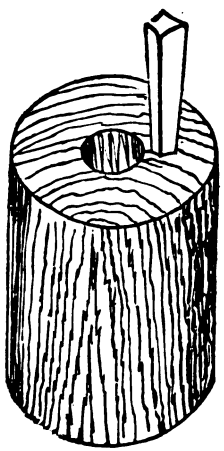
occupying the bore receives the heat by radiation, in the intervals between firing quickly, from the immediate surface, and less quickly a little distance beyond; and so again the heat flows from the metal of the gun with reduced velocity as the distance increases from the bore, leaving the point of highest temperature in the mass of metal, but not far from the surface of the bore. (*See Fig.* 13.) Its effect toward causing rupture may be illustrated by taking a cylinder of pine wood a few inches in length and a cross-section like the diagram, and providing a wedge similar in form to a bayonet, but truly tapered to a point from a cross-section at the head, the same as the lines representing the place and quantity of heat on the diagram, showing its effects by *intermittent communication* of heat. (*Fig.* 13.) If the point of this wedge be set upon the end of the wooden cylinder at the point supposed to be the point of greatest heat, according to the theory above, and by a blow driven into the end-wood, it will penetrate so as to make an impression like the inner line of the diagram. A second blow, driving it further into the wood, pene-

Fig 13.





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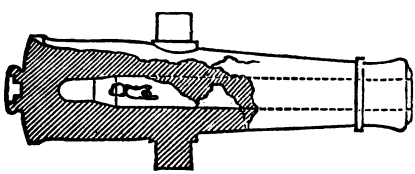
trating as if to the second line of the diagram, and expanding the wood, *will cause a fracture inward toward the surface of the bore first;* a third or fourth blow will split it to the outside. And thus guns burst, *the first fracture occurring on the inside, and afterward opening to the outer surface.*

It is often noticed as a curious phenomenon when large guns burst, that notwithstanding the chase or forward part of the gun, several feet in length, may be thrown many feet end over end, the shot passes through the chase the length of the bore without being diverted from the direction of its aim. This fact corroborates the theory under consideration, as it is evident that the shot is not projected by the same force that bursts the gun—the communication of heat to the inner metal of the gun requiring a longer interval of time, and gun metals being comparatively non-conductors of heat. In Rodman, Plate II., Fig. 2, is shown the interior line of fracture of a 10-inch columbiad. Here a thin bit of metal, indicated by the line marked  , is shown, which seems nearly to envelop the bore. Nearly one-half the re-enforce was broken off this gun in the same manner as chips break off a stone door cap when a building is burning, but in this example the outside of the stone is first heated while the inside remains colder. The outward *pressure* of the powder at the time of this fracture would surely have

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carried away so thin a piece of metal; but it remains standing *to show that the pressure had been reduced before the gun broke*—a remarkable evidence of the true cause of the bursting of the gun. The diagram exhibiting the place and quantity of heat shows but little heat at any of the surfaces of the gun. From this, also, we may have been hitherto deceived as to the importance of the study of its effects, and we can only appreciate it by some experiments like the following: a clean rifled musket, the barrel of which weighed about five and a quarter pounds, was fired twelve times with the ordinary charge, at intervals of five minutes between each discharge. The time during which the surface of the musket was radiating away the heat from beginning to end was, therefore, about one hour. At the end of this time its temperature was 200°. The radiation was somewhat hindered by the wood of the stock, which was a non-conductor, partially enveloping the barrel, and the burnished surface of the barrel, which was a non-radiator. The whole amount of powder was less than one ounce, and it communicated this great amount of heat to five and a half pounds of metal. There would be a material difference in the amount of heat communicated in this experiment, if the barrel were not clean inside, as the residuum of powder would be a non-conductor, and would prevent its communication to the metal of the barrel. The temperature of the gases in a large gun, say a 100-pdr. rifled cannon, would be much greater than in a musket;

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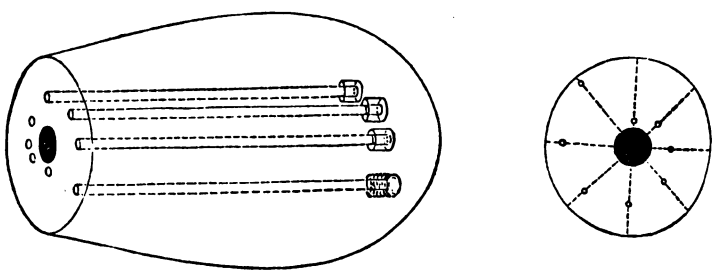
as the temperature is increased as the resistance to the expansion of the powder is increased. The work of the powder in a gun is to overcome the inertia of the shot, and to do this it presses against a certain number of inches of area. If the shot be short, the pressure is still exerted against the same area. The projectile in a 100-pdr. rifle gun is about 12 inches in length, while the projectile from a common rifled musket is less than one inch in length. The resistance from the inertia would be thus about twelve times as great in the large gun as in the small one, and the expansive force or pressure and, consequently, the temperature high in proportion.

The ordinary meters, if used to measure the temperature communicated to the gun, as shown by the preceding argument, will be inefficient, as they can not be applied at the place supposed to be the seat of the highest temperature. A meter for this purpose can be prepared in the following manner:



Take a gun with eight inches thickness of metal about the bore, cut off the chase at that point of its

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length where the metal is five inches in thickness, then lay out the face of the muzzle with eight radial lines, equal distances apart, and beginning upon one drill a hole parallel with the bore, half an inch in diameter, coming out at the breech and leaving half an inch of metal between the bore and the hole thus drilled ; then drill another hole on the next radial line through lengthwise, one inch from the bore, and so on, each hole being half an inch further from the bore, until the outer one is four inches from the bore. Fit bronze rods into these holes, and fasten them at the breech with screws, so that they can have no motion endwise at that end, then file off the ends of the rods flush with the muzzle, when the gun and the rods are at the same starting point of temperature, say sixty degrees, and we shall have a thermometer that will give nearly a correct indication of the quantity of heat communicated to the gun from a calculation based upon the difference of expansion of the metal of the gun and the bronze rods, and a positively correct indication of the place of highest temperature and, consequently, greatest expansion with any number of discharges. To retain a record of the place and quantity of heat at any of the successive discharges, make a number of moulds, and fill them with a composition of wax and powdered charcoal with which to take an impression of the face of the muzzle. These moulds should be numbered and recorded at each successive discharge. Charges should be made with heavy and light projec-

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tiles, and with no projectiles at all, and at long and short intervals between the discharges.

The deductions drawn from these experiments would give us positive knowledge on this part of the subject, and relieve it of the mystery so often referred to by ordnance inspectors; while without the knowledge thus attained, officers of our army and navy seem to be without justification, should they place large guns in our expensive iron-clad ships and fortifications, made without consideration of the important cause of failure herein presented.

From the fact that solid-cast guns, of the largest size now in service, have a certain strain upon them within themselves when cast, from the heat leaving the inner metal last, which is relieved by the expansion of the inner metal by the first few discharges, I hold that solid-cast Dahlgren guns, or any columbiads of large sizes, cast solid, may pass the inspection of ten service charges, and be stronger at the tenth discharge than they were at the first—that number of rounds, perhaps, being necessary to relieve them of the before-mentioned strain, by communicating the proper proportion of heat to place them in the same state in which we find the hollow-cast gun at the first round.

The guns in our service having great thickness of metal about the bore, should not be relied upon in rapid firing, even when exposed to the hottest rays of the sun on their very large exterior surface—the most favorable circumstances under which a gun can be fired—and should never be fired at all, if a hollow-cast

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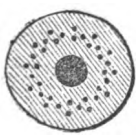
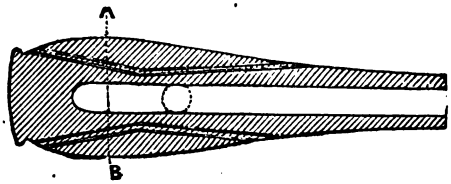
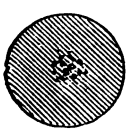
gun with uniform density throughout the mass, in rain or in cold weather. It may sometimes happen that a hollow-cast gun, after the Rodman plan, would exhibit greater endurance than a solid-cast gun, made from the same metal and at the same time. At the time of the bursting of two large steel 50-pdr. navy guns of my fabrication, each at the ninth round, fired rapidly on a cold day at Staten Island, I suggested to the Inspector either that the guns should be fired at longer intervals between the discharges, or that I should be permitted to give elasticity by drilling a series of small holes about the bore, having a certain position relative to each other, and a proper direction to permit the





expansion of the inner metal without any undue strain upon the re-enforce. Captain Rodman's book, page 297, exhibits the impossibility of casting a solid projectile, cavities being formed in the centre of the mass,



due to the shrinkage of the inner metal after the outer shell had frozen, so as to prevent any supply of metal to the centre thereafter; and this is related as the cause which led to the hollow mode of casting. These cavities do not occur of necessity in the centre of a casting, but of necessity in the centre of the mass at equal dis-

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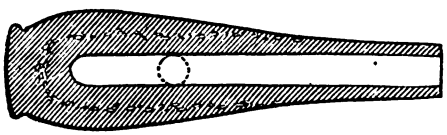
tances from the cooling surfaces if subjected to an equal rate of cooling; and they are to be found near the centre of the mass in the Rodman gun as well as in any other. Their presence can not be detected at any of the surfaces of the casting. *If they were generally distributed between the inner metal of the gun and the re-enforce, a sufficient elasticity between these parts of the gun might be had, and a similar result arrived at to that obtained by the drilling of the holes*, as shown by diagram. Their presence would account for the occasional endurance of hollow-cast guns, but the uncertainty of their uniformity would account for the irregularity of this endurance. The Rodman 15-inch gun, fired at Fortress Monroe, stood the indifferent test to which it was subjected, perhaps, from the occurrence of this uncertain elasticity, and from the fact that it was fired under a hot sun, with slow-burning powder, hollow shot, and windage. Even this questionable success would rarely again be obtained, as the requirements of service are unlikely to permit such favorable circumstances.



The 15-inch guns have been shown to be inefficient, therefore, for they only give a velocity of 750 feet per second; or they are unreliable (perhaps both), for they will burst as often as the accidental porosity above spoken of is not evenly distributed between the inner metal and the re-enforce. And who can say

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when these conditions are all fulfilled, except by a practice inaugurated by the man "who had the goose that laid the golden eggs," viz., BY CUTTING OPEN. By that practice, THE GUN THAT WE KNOW TO HAVE BEEN A GOOD GUN, IS NO LONGER A GUN.

I leave the subject now to be considered by those who have read so far in these pages, but with this remark, that I have shown that no large gun ever made could be pronounced a good one until it was burst or cut open. Yet I believe that it is possible to so construct a gun that not a single trial shot need be fired for the purpose of demonstrating its good qualities. That through the light I have thrown on the subject, reliable guns can be constructed of any required size, and to give any required velocity, but little lower than the unrestrained velocity of the gases along the bore.

When I proposed to show that the heat evolved from the burning powder in a gun was the principal agent in bursting, I found ordnance officers opposed the theory, on the ground that but little heat was communicated to guns. This was said to me by Major Wade, by Captain Rodman, and indirectly by several others occupying high positions. Major Wade, however, afterward told me he recollected having seen copper melted by the heat of powder, at a time when a few kegs of powder exploded in a powder-mill. Captain Rodman, in a part of his book before quoted, speaks of higher temperature exhibited when

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larger masses of powder is burned in an 11-inch gun, than in a 7-inch, as accounting for three times the force in the larger gun than in the smaller; and Captain Dahlgren, in his report to the Secretary of the Navy for 1862, says a gun was so heated by firing, that it was afterward eighteen hours in cooling. Now I have never claimed that heating a gun would burst it, or that cooling it would burst it; but that heating or cooling one part of the gun to a certain extent, while the rest of the gun was at the opposite state of temperature, would burst it, and the extent of this unequal expansion necessary to burst the gun must be greater than the elasticity and ductility of the metal of the gun. I have also included in my argument the compressibility of the metal; but as compressibility goes before elasticity, and as the gun would be destroyed as effectually if its compressibility was great, by permanent enlargement of the bore, as if it were burst, it is not necessary to include it in a general statement.

GREAT GUNS.

For iron-clad ships and for revolving forts guns require to be constructed in a different manner from those heretofore used, or those for other purposes. But whenever a gun is produced that will penetrate iron-plate of the greatest practical thickness that can be carried on a ship's hull, the day of iron-clads

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will have gone by, and the fast sailing and manœuvering steamships, on which must be mounted guns capable of giving extremely high velocities, will take their place. It is questionable, whether rams are not superior for assault to any iron-clad ships. It is at all events certain, that a ram with the best guns would be very formidable, and for many purposes, such as defence of harbors, etc., it will be indispensable. We shall always, however, want large howitzers, for earthworks, where cities have to be protected by a long line of fortifications, and the number of guns required for such a purpose, makes it necessary that a cheap gun of that class should be provided—one that can be produced with despatch and is capable of endurance, even if of a large size. Of the great number of practical inventions which I have prepared to meet these conditions, I shall confine myself to describing three general plans of guns which I have devised, viz: a spherical compensating gun, adapted to a turret; so constructed as to be absolutely safe from bursting when fired with quick burning powder. So mounted, as to be capable of being worked by steam or by mechanical labor, and so protected, especially when it is adapted for a fort, as to be absolutely safe against penetration of any projectile or part of projectile, the turret having no open port. Second, a gun so constructed as to be absolutely safe from bursting, no matter what charge is fired in it, it having strength to resist the full pressure of the gases of powder, if confined within its bore,

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even although the pressure was as great as some of the ridiculous estimates heretofore noticed; so arranged, that much higher velocities can be given to the shot than has heretofore been deemed possible, and which it is practicable to make of any required size to possess these qualities; and the third a cast iron gun or howitzer, that can be produced for one half the cost of the Dahlgren guns, and which I believe is practicable for a calibre of twenty inches.

It being my intention not to propose at any time, any invention of my own, and press it as an improvement that I have adapted to meet the conditions, until I have, after careful consideration, found it to be essential to success, I have felt some hesitation, from the fact that I have discovered a necessity, for proposing a whole new system, for which a variety of guns, turrets, or carriages and implements had to be devised; yet this will not create so much surprise in the minds of those who have read the preceding pages, if they have noticed that conclusions, exactly the opposite to those drawn by the theorists who have written on the subject, are unavoidable, even from their own examples. I hope my conclusions will not be considered less reliable, because I have discarded the terms and symbols of the higher sciences. I have endeavored to explain the subject clearly and intelligibly without their aid, as I know that there is a large class of persons who will prefer to examine the result of my labors in Anglo-Saxon, not interspersed with algebraic characters.

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Guns mounted in turrets, in the ordinary manner, are liable to the serious objection that a part of the port is always open, and projectiles, or part of projectiles, may enter, especially if the enemy aim to project their shot against the protruding muzzles of the guns, in which case, from their liability to bound and rebound in the limited space inside the turret, they would be fearfully destructive. This error is corrected in the adoption of a spherical gun to the turret, hereinafter described.

The proper ventilation of a turret is also an important consideration. Sudden and complete changes of the whole atmosphere within a turret, constructed in the ordinary manner, would be required to remove the gases of powder that enter the turret from the vent of the guns, and the gases liable to flow in through the open space about the guns in the ports. It would be improper, in most cases, to draw these foul gases downward into the ship or fort; and to eject them by a current from below would involve the passage of foul air from below to the men occupying the turret to work the guns. In the actual shock of battle the exercise of the men must of necessity be violent, as their number must be limited and their duty severe, from the necessity of making a formidable assault with a limited number of guns, and hence the importance of superior ventilation. I have succeeded in relieving the subject of all these difficulties by the devices for keeping the port and vent closed, in the manner of mounting the

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guns, and working them by steam or by hand, with the workmen and gunners below, hereinafter described.

I propose first to describe a spherical gun, and a turret to which it is adapted. The gun is designed to afford extraordinary strength, by reason of the great thickness, peculiar arrangement of different materials, a large proportion of which are of low cost and easy preparation, and approximately complete compensation for the greater heat of the interior which it provides.

When it was found necessary to correct the error in time-keeping machinery, clocks, chronometers, etc., due to variations of temperature, compensating devices were provided, designed to take advantage of the different degrees of expansion for certain increments of heat, exhibited by different metals. A gun can be made of such a combination of materials as will resist the pressure or expansive force of the powder, while it provides compensation for the communication of heat to the inner metal as completely as the pressure of the powder alone has been heretofore provided for. As before stated, these considerations not applying to small guns, it is proposed to describe the manner of constructing a very large rifled gun, with a calibre sufficient to project a ONE THOUSAND POUND shot. The gun, when completed, is of fourteen inches calibre, and weighs fifty-one tons; or about one hundred times the weight of the powder and projectile. It is composed of three metals—steel, bronze, and lead. These metals expand, with heat, in about the following proportions:

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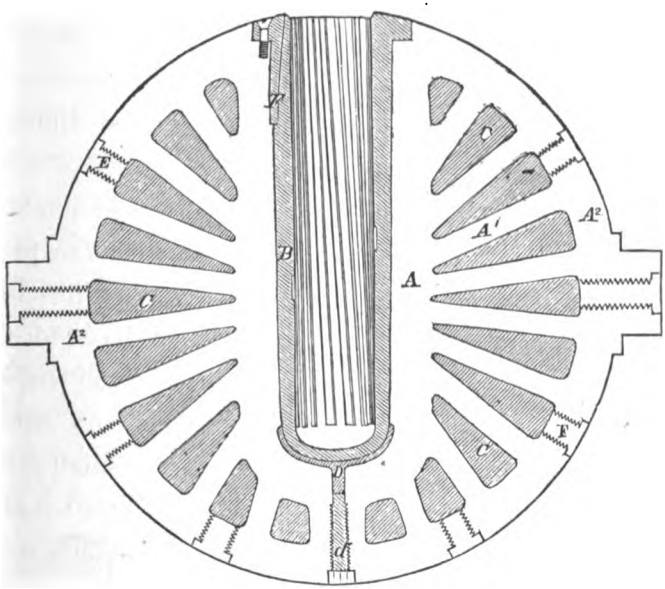
Steel expands	11
Bronze "	19
Lead "	28

Their relative conducting powers are—

Lead	180
Steel	360
Bronze	1150

The gun, thus composed of three metals, according to my invention, is exhibited in the following section.



The bronze casting *A* 2, is a hollow sphere, seven feet in diameter, cast upon a core, leaving six inches thickness of metal. A cylindrical centre *A* on one axis, has also six inches thickness of metal, and stays, A^1, four inches in diameter, radiate from the centre of the ex-

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ternal form, connecting the cylindrical centre A with the outer shell A^2. These stays A^1 I term conductors of heat. The outer shell A^2, and the hollow cylinder A, that envelops the steel lining being of uniform thickness, and cooled from all surfaces, will be a casting without strain, having been uniformly cooled. The core that forms the chamber between A and A^2, is supported in its proper place by distance-cores through the outer shell A^2, resting upon the outer case of the mold. Through these distance-cores E are vents, by which the gases and heat from the chamber-core escape as the metal flows into the mold in casting.

The first operation after removing the gun from the mold, is to remove the sand, of which the chamber-core is composed, through the holes left by the distance-cores, and then to clear out the chamber with acid, in order to remove any sand that may adhere to its surface. After cleaning the metal casting thoroughly, the whole external surface of A^2 is hammered, for the purpose of compressing the metal to its greatest density, and it is designed to affect the density of the metal to about half its thickness. The interior of A, to be afterward lined with steel, is enlarged by pressure obtained by small rollers revolved by a sleeve, with a shaft for its centre. The rollers are pressed outward against the surface as they revolve, by wedges, until the whole surface has been passed over many times, thus enlarging the diameter, by a pressure on small surfaces, until the density of the metal is also affected in this part to half its thickness.

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The holes left by the distance-cores are then, with the exception of one, stopped by screw plugs *EE*, etc., after which the chamber is filled with melted lead *C*. After the gun has cooled, a hydraulic or other press is attached to each of the holes in succession, and additional lead, in this manner, is forced in, to give the same amount of compression to the inner surface of the chamber as had been given before to the outer surface by hammering, or until the outside shell is slightly expanded. By this means, most of the compressibility of the bronze is taken up, and its elasticity much increased ; as, by hammering, a spring temper is imparted to the bronze, giving it the elasticity of spring steel. The lead also answers the purpose of a conductor of pressure from its incompressibility.

The bore of the bronze *A*, to receive the steel lining *B*, is tapered, being about one inch smaller at the breech than at the muzzle. The steel lining is turned a very little larger than the bore, and with a corresponding taper, and is also forced into its place by a hydraulic press. The bronze metal about this steel lining has a strain of compression upon it from the pressure of the lead, and a strain of compression also rests upon the steel lining. Any pressure having a tendency to enlarge the diameter, would be resisted directly by the strength of the outer shell, as when the gun is completed, it is intended that nearly all the compressibility of the bronze shall have been destroyed by the hammering, and by the pressure of the lead, as well as a great part of its

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elasticity, by forcing the steel lining with great force into the tapered bore. The steel lining is to have only a sufficient thickness to retard a part of the heat in the combustion of the powder; so that the proper proportion of heat is communicated to the bronze, and this proportion is regulated by the thickness of the steel lining. A space is left in the bore of the cylinder *A*, and after the insertion of the steel lining *B*, this space is also filled with lead *D*. By this means, careful fitting of the steel *B* to the bottom of the chamber in *A* is obviated, and after the lining *B* is forced in, against the shoulder at the muzzle end, a proper amount of pressure can be equally distributed about the spherical end of the steel lining. And during the service of the gun, this pressure can be corrected by the use of the screw *d*. The steel lining *B* is prevented from changing its position by any shock to the gun by two keys, *FF*, inserted in such direction as to prevent withdrawal of the lining, without first withdrawing the keys. They also prevent the lining from revolving in the gun, by the pressure of the shot against the side of the lands.

Bronze is one of the best among the conductors of heat, transmitting it with rapidity. The heat conductors A^1 radiate from the centre of the sphere, and the bottom of the bore is continued beyond the centre of the sphere, so that the mean centre of heating surface may be at the centre of the gun.

The lead is a conductor of pressure, it being more nearly incompressible than any other of the metals, which renders it eminently fit for this purpose.

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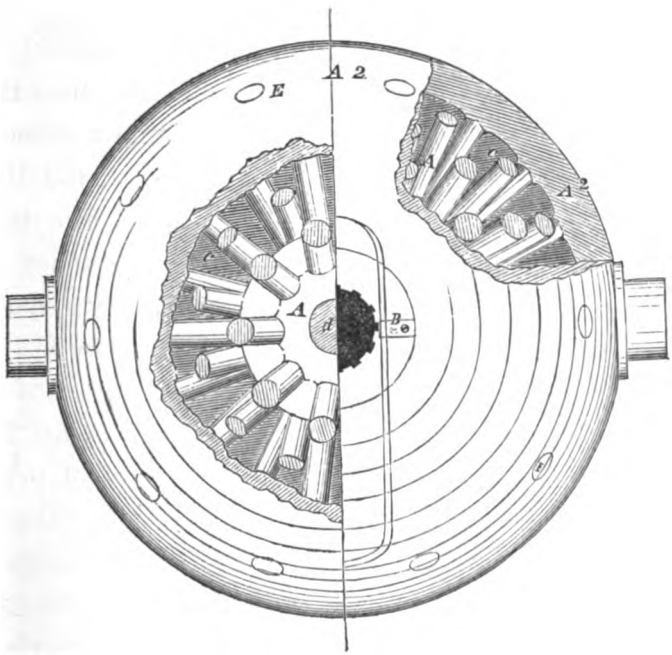

The right hand side of the above figure is half of a front elevation; and the left hand side of the same figure is a rear elevation, both with a part of the shell removed, in each case, to show the interior arrangement.

The enlargement of the bore of this gun by pressure of the powder would require, therefore, the overcoming of the inertia of the weight of a frustrum of a cone, without compressibility from each square inch of surface against which the pressure of the powder is exerted. The projectile being a cylinder, elastic and compressible, its inertia would be easier overcome than any frustrum of a cone of the metal of the gun;

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having equal area at the surface of the bore, against which the pressure of the powder is exerted, its inertia would have to be overcome almost instantly throughout its whole length, because of its resistance to further compression; while the inertia of the shot would be overcome gradually, or in successive disks of its length, because of its undiminished compressibility. The addition of the tensile strength of the metal of the gun makes it probable, therefore, that this gun can not be burst by the pressure of the powder, if the shot is free to move forward. I suppose this gun has sufficient length of calibre to utilize nearly all the expansive force of quick burning powder, occupying not more than one-fifth of its length of bore.

The spherical form of this gun gives a great advantage, by allowing the gun to be simply rotated on its trunnions, in order to be loaded without exposing the men by the presence of any open port-hole, and the gun is so nearly balanced upon its trunnions *H*, as to be worked with great ease, notwithstanding its weight, 51 tons. The gun is graduated on its periphery for adjustment to the proper elevation.

The following illustration shows the guns as mounted in a turret, for a fort or water-battery. The manner of mounting and operating is such as to allow them to be loaded without exposing the men to receive missiles through the ports, so arranged that each gun is braced by another; and that the inertia of the entire

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structure is made available to resist recoil. It shows also the means adopted to facilitate the working and repairs.

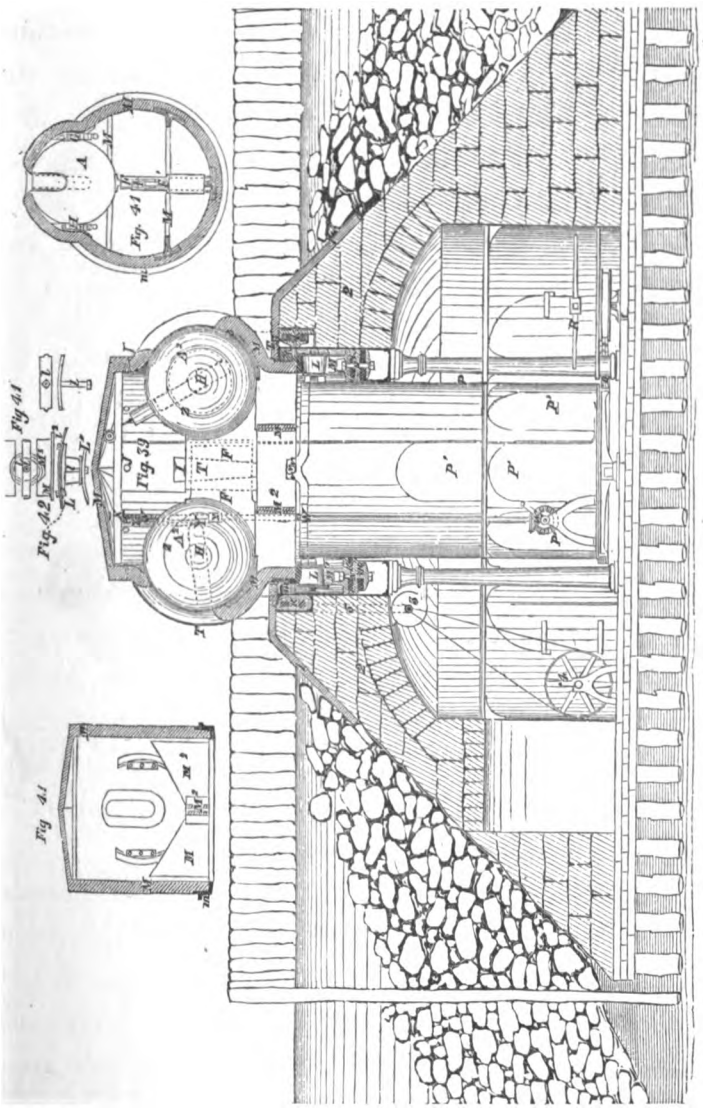

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Figure 39 is a side elevation of two spherical guns, mounted according to this portion of my invention. The guns may be, in all respects, like that shown in Figures 5 and 6, or may be differently constructed as may be preferred.

Figure 40 is a section across the turret, on the line *SS* in Figure 39, with certain parts removed. Figure 41 is a horizontal section on the line *TT* in Figure 39, with certain parts removed.

A^2 A^2 represent the guns. The trunnions *H* are mounted in bearings *G* in the inside of the turret *M*, and the spherical form of the guns allows each to be rotated to any extent desired, without uncovering the port. I allow each gun to move inward to a small extent before rotating it, the bearings *G* being adapted to allow such motion and to induce it by the gravity of the gun, so soon as the parts which prevent such motion are removed.

FF^1 are substantial cheeks, or moveable braces, standing so that one is partly embraced and sustained by the other, and *I* is a stout wedge, adapted to operate between these cheeks, and by their aid, to brace the guns outward very rigidly. I force outward both guns so that they apply themselves firmly to the interior of the turret, before firing either. When the gun represented on the right hand side of the figure is fired, its tendency to recoil is resisted, first, by its own inertia; second, by the inertia of the cheeks FF^1 and wedge *I;* third, by the inertia of the gun on the left

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hand side of the figure; fourth, by the inertia of the entire turret *M;* and, finally, by the elasticity of masses of rubber *K* and K^1, which are introduced in the manner represented.

On the scale represented, the guns are fourteen inches calibre, and weigh each fifty-one tons; and on any scale which may be assumed, each gun weighs about one hundred times as much as the charge which is fired therefrom. The recoil of such guns, thus braced and provided, will not be so great as to occasion serious inconvenience. *L L* represent rollers which support the turret *M* and its attachments, and allow it to turn freely. M^1 represents the circular track or stout ring, on which the rollers *L L* traverse. *N N* are holding-down bolts which pass through the rubber *K.* and are adapted to allow much lateral movement. *P* is a hollow cylinder of iron, provided at the bottom with large doorways P^1, to allow the ingress and exit of the men, and with gearing *Q*, and a capstan *R*, by which it is rotated. This cylinder is connected with the turret *M*, through the aid of strong pins or projections *V*, which stand in suitable jaws *v*, on the inside of the turret at its base, and compel the turret to turn therewith, while at the same time allowing for slight imperfections in the adjustment of the parts, by the liberty of the projections *V*, to move vertically in the jaws *v*. *W* is an endless screw adapted to be rotated by the winch *w*, near the bottom of the structure. It stands near the rear face of one of spherical guns A^2, and a like screw, not re-

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presented, stands near the opposite gun. $X\,X$ are two nuts which are carried on the same screw W, and which are moved simultaneously, up or down, according as W is turned in one direction or the other. $Y\,Y^2$ are wire ropes which are wound each partially around the gun, fitting tightly in a groove in a piece Z, bolted on the gun for the purpose. The rope Y is attached to the nut X, and the rope Y^1 to the nut X^1, and both ropes are firmly secured to the gun. These ropes and nuts incline the gun in either direction and to any extent which may be desired, by simply turning the screw W in the proper direction by the crank w.

I provide strong heavy beams $\mathrm{M}^2\,\mathrm{M}^2$ across the base of the turret M, in the directions represented. These sustain the weight of the bracing parts and resist that portion of the recoil which is directed downward when the guns are fired at high elevations.

The iron covering 1 which is applied upon the masonry 2 around the base of the turret M is very strong, and is held down by bolts not represented. A heavy flange m extends outward from the base of the turret M, and stands under the inner edge of the iron covering 1. This guards the turret from being overturned by any chance or by any severe recoil of its guns.

The blower 3 is operated vigorously by the crank 4 during an action, and by drawing in air through the pipe 5 induces a plus pressure in the entire structure. This pressure induces an upward flow of air through

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the cylinder *P P*, and turret M, the air finally escaping through apertures in the top of the turret.

There is an intermediate floor 6, in the cylinder *P*, and a ladder for moving up and down therein, may be arranged in any obvious manner.

Sight holes *J J*, are provided as represented, which may be furnished with mirrors and other approved appliances if preferred.

Figure 42 is a plan view, showing one of the rollers *L*, on which the turret M turns, and the rings L^1, L^2, which connect the rollers and compel them to maintain uniform distances, each from the other.

When it becomes necessary from any cause to take out or replace one of the rollers *L*, I have provided means of doing so without lifting the turret M. Figure 43 is a side view of one part of the circular track M^1, where this is accomplished. A slight shaft, or guide spindle *l*, is inserted through each roller *L*, and the outer end is provided with a T-shaped part l^1, which is bolted to the outer ring L^2, as represented.

To take out a roller I turn the turret until the defective roller comes to the position shown in dotted outline in Figure 43. I then remove all the bolts which hold the several parts l^1 to the outer ring L^2, and raise or lower L^2 out of the way. I then remove the nut which holds the defective roller to the inner ring L^1, remove the guide spindle *l*, and the defective roller is then free, except that it is still supporting its share of the turret, and consequently can not be drawn

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out, being prevented by the flange on its inner end, as also by the friction due to the great load resting on it.

I next remove the small portion M^3, from the circular track M^1, it being made in a piece separate from the other parts, to allow its removal for this purpose. I then turn the turret until the defective roller is brought over the place where this piece M^3, stood, as shown by the dark lines. The previous removal of the piece M^3, now allows the defective roller to be readily withdrawn, because it readily falls down by gravity out of contact with the turret M, leaving all of the weight to be supported by the remaining rollers; and the space made by the removal of M^3, is sufficiently wide and deep to allow the roller to be removed and a new one substituted, after which a reversal of the process, above described, makes all again complete. Figure 43[a], shows a front elevation of spindle l, showing slight projections l^2, which hold l^1, in horizontal position, l^2, being removed.

There must, of course, be a suitable passage at the point required through the masonry to allow access to the place in the circular track, where this operation is performed.

The fort above described was designed for New York harbor, to be erected in the centre of the river at the Narrows, and for other like places. The number placed in one channel can be as great as desired, but the size of the fort, or the number of guns for each fort, should not be increased.

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The foundation must be according to circumstances. On a rock bottom piling would not be necessary or possible. The stone-work could not be injured by shot from the enemy's guns, for it is practicable to cover its small exposed surface with plating that would resist any shot. The piles driven about it would be a sufficient harbor-breakwater, and the loose rock deposited about it would insure safety against an assault of rams.

The men and magazines are so far below the water as to be protected, and then a turret of any required thickness can be placed upon it, sufficient to resist the shot of any gun now made or to be hereafter made. There is no port or other opening through which the smallest projectile could enter, and no men in the turret to be injured if there were. The guns are absoutely safe from bursting, even when of a size to throw a sufficiently heavy projectile to crush any ship that can be floated into the harbor. I offer it as an impregnable fort with irresistible guns. It can be constructed in less time and at less cost than any other of equal qualities.

A variety of new forms of projectiles seem to be required for these guns, for the necessity for large guns comes from the important changes in the mode of constructing ships of war covered with iron armor, and the projectiles for attacking these, successfully, would be the same whether the enemy were opposed by our guns on ships or fortifications. Those repre-

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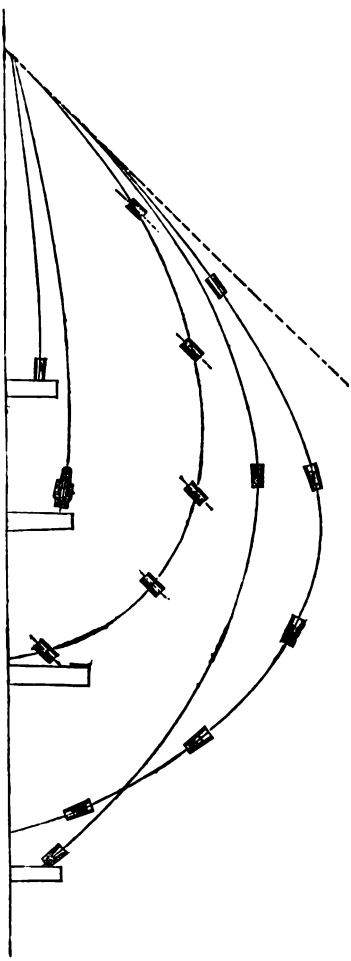
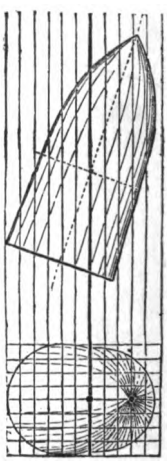
sented are solid shot and shell, 14 inches in diameter, and 28 inches in length. All these projectiles, it will be noticed, have their GREATEST DISPLACEMENT (as they are projected through the air) AT THEIR REAR END. BUT THEIR CENTRE OF GRAVITY IS FORWARD OF THEIR CENTRE OF FORM. A shot fired from a rifled gun at high elevation, is inclined to keep the same direction or angle of its axis, about which it revolves, and during the last half of the trajectory this direction comes to be nearly a right angle to the direction of its flight. The resistance to its forward motion is at its displacement of air. If its





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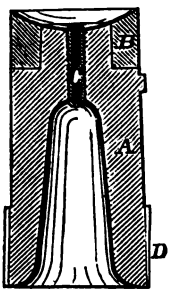
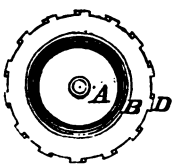
greatest displacement be aft, the resistance of the air (when the projectile is moving in the direction of the parallel lines) against its sides inclines to bring the rear end of the shot backward, so that its axis coincides with the line of flight. The centre of gravity being forward of the centre of form, would assist in depressing the forward end of the shot as the line of the trajectory was depressed. The figures show a longitudinal section, and a rear view of one form of my invention which has the required qualities to an eminent degree, and is thus adapted to the penetration of iron armor plates AT A LONG RANGE *with a high trajectory*, STRIKING POINT FOREMOST.





The main body *A*, of the projectile is of cast iron, the ring *B*, is of steel, hardened. The front of the projectile is concave. The screw bolt *C*, is of iron, and merely fills a hole which is made by a suitable core in casting to secure more uniformity in the metal while cooling. The rear portion is provided with projections *D*, adapted to correspond with, and fill as closely as desirable, the rifle grooves of the gun, and the forward portion is provided with three *boutons* or projections *E*, which may rest upon the lands of the gun, and which compel the forward part of the projectile, though smaller than the bore, TO MAINTAIN A CENTRAL POSITION THEREIN. The next figures are a

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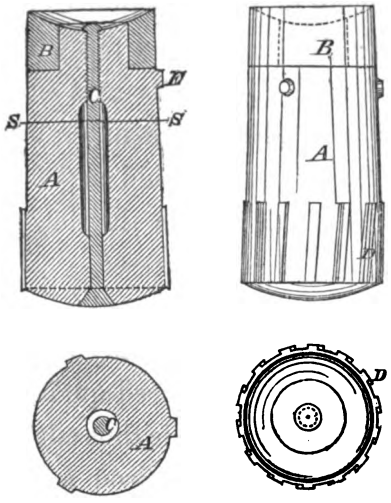
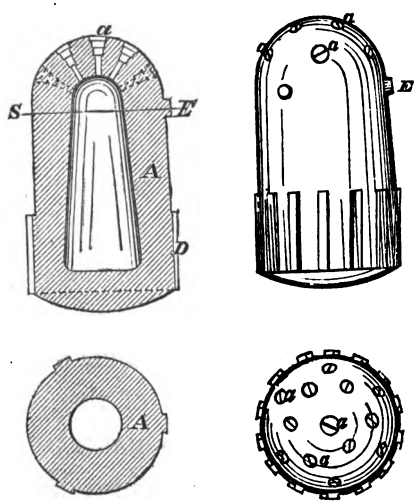
front view and a side view of another *form of my invention*, intended to operate against iron armor AT SHORT RANGES. It is SOLID throughout, and differs but little from the long range projectile described, except that it has not the hollow rear —it is cored and filled with a screw bolt *C*, in the centre as already described. It is *intended* to weigh ONE THOUSAND POUNDS.



The next four figures are a cross section of a hollow shell with a rounded front, and a cross section of the same on the line *SE*. This shell is provided with thirteen plungers *aa*, etc., adapted to explode by concussion. These RADIATE IN SO MANY DIRECTIONS, that some one may explode if the shell STRIKES IN ANY POSITION. A time primer is added when it is required that the shell shall penetrate before explosion. This



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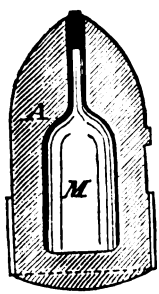
shell is adapted TO BE THROWN INSIDE OF FORTS ON ELEVATED POSITIONS or into cities, where, from the height of the trajectory, it has been heretofore difficult to ensure the explosion of percussion shells. It will usually explode upon striking, if it is tumbling end over end, it being likely to explode on striking in any position excepting that of a fair blow with its rear end. Another kind of shell is shown, and the figures are a side view and a front view of a projectile intended to act as a time shell, and which is adapted to receive an ordinary or any approved form of time fuse. This shell is constructed according to the theory shown by the trajectory lines, and the GREATER WEIGHT IN THE FORWARD PART of this projectile, when the cavity *M* is filled with powder alone, is very marked, while THE GREATER DISPLACEMENT of the REAR portion of the shell, and the *boutons* to steady the small front portion in the gun, are like the projectiles previously described.



The attainment of a very long range, or the penetration of iron armor, requires the highest velocity possible to be attained. To meet this necessity I have provided a gun, in which the length of the gun is proportioned to the size of an enlarged chamber that contains the powder, from which is evolved a sufficient amount of gas to keep a high expansive force against

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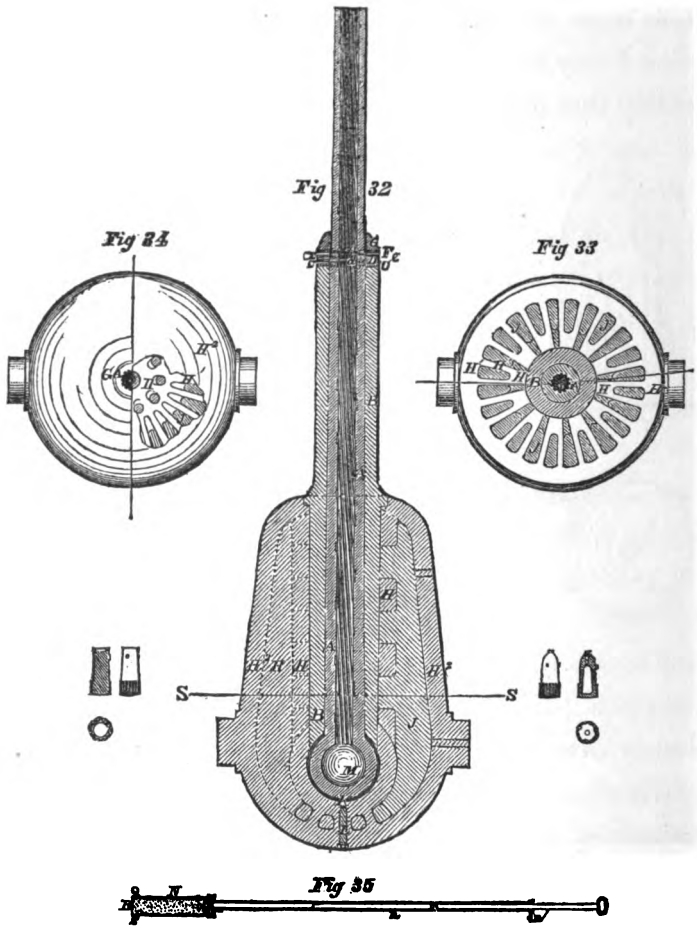
the shot a longer than ordinary time, and the use of this device is made practicable by the devices of compensation, and modes of attaining great strength exhibited in some of the guns hereinbefore described.



The Figures represent a longitudinal section of a gun, constructed according to this portion of my invention, and a cross section on line *SS*; also, a Figure of

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an end elevation, the right hand side being an elevation of the rear end with a portion broken away, and the left hand side an elevation of the front end. *A* is the inner lining of steel constructed in the form represented, so that there is a chamber *M* larger than the main bore of the gun. This chamber *M* is bored without difficulty, by means known to workers in metal, and contains, in a form adapted to facilitate its rapid ignition, a much larger quantity of powder than can be burned, with advantage, behind a shot in guns of the ordinary construction. *B* is a covering of bronze forced tightly upon the lining *A*. The inner surface of *B* and the outer surface of *A* are tapered slightly; the rear end of *A* being largest. This facilitates the production of a very tight fit of these parts, but care must be taken that the thickest part of the steel lining *A* be not too great. I prefer to make this thickness, if the gun be large, about three and a half inches, as otherwise the difference in the temperature between the inner and outer particles induces a serious strain.

C, *D*, *E*, and *F* are heavy washers of steel, prepared with a spring temper, and touching each other only at a few points by the aid of the projections *d*, *e*, and *f*, arranged each in a different part of the circle from the next, so as not to coincide in position, but to differ as widely each from the other as possible. This, as will be readily understood from the drawing, allows the elasticity of the washers to be brought into play.

G is a nut fitted upon the steel *A* by a screw thread,

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as represented. This is applied against a washer *F* with considerable force, so as to compress or bend, slightly, all the washers between itself and the washer *C* resting against the bronze *B*.

H is the inner shell and H^2 the outer shell of a bronze casting which is forced or shrunk on over the parts before described. This casting is filled with lead *J*, and compressed, and is provided with braces H^1, which connect the inner shell *H* with the outer shell H^2. A quantity of lead *K* is also introduced between this casting and the spherical chamber, and held by a screw *L*.

It will be seen that this gun possesses the compensation for unequal heating which forms so conspicuous a feature in some of the guns before described, and in addition stores in its capacious chamber *M* so large a quantity of powder, and allows it to burn so quickly, that the great initial pressure which is usually felt by the projectile during the early portion of its movement, is continued further than usual toward the muzzle, acting a greater length of time against the shot to accelerate its motion, analagous to the motion of mercury in the tube of a common thermometer, due to the expansion of the large quantity of mercury contained in the bulb. If a thermometer were constructed without the bulb, the expansion of the mercury in the tube, only, would not be sufficiently apparent to give room for graduations, but by the addition of the quantity in the bulb, affected by the change of temperature, the

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motion along the tube is very great, and can be proportioned to give any required amount of motion in the tube, if the bulb could be made to resist the forces acting upon it. And these are exactly the conditions required in a gun to attain the highest velocity. I believe my mode of constructing this gun will allow the successful use of this idea, but without my plan of compensation the structure would be destroyed by the joint effects of the high mechanical pressure, and the heat to which it would be subjected.

Figure 35 represents an implement I have designed for loading such a gun. *N* is a cylinder of copper, and *n* is a hollow wooden stock by which it may be reached into the gun. n^1 is a stop which rests in and against the muzzle when the loader is fully in place. The cubical contents of *N* are equal to that of the chamber *M* of the gun.

An elastic disk or wad *O* is placed upon the convex face of the plunger *P*, then the powder for a charge is introduced into *N*, next a sheet of paper *R* is placed over the end of *N*, and, lastly, a ring *S* is slipped over the edges of the paper, holding it strongly to *P*. The loader and its contents are next introduced into the gun, until the stop n^1 rests on the muzzle. The plunger *P* is then forced inward by the rod *p* passing through the stock *n*, bursting the paper *R*, and shoving the powder *Q* into the large chamber *M* of the gun, and also forcing the wad *O* in and allowing it to expand into such bore, so that it will retain the

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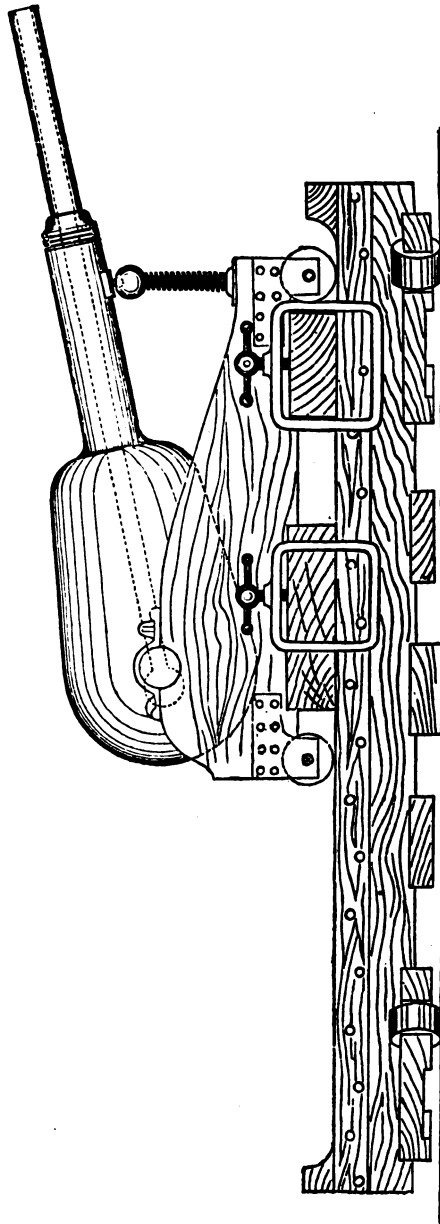
powder. The loader is now withdrawn, and the projectile introduced in the ordinary manner. This avoids the trouble which might otherwise be met in filling the chamber *M* with powder, while the gun is in a horizontal, or nearly horizontal position.



A pivot carriage adapts this gun to be used on the deck of such a ship as the Vanderbilt or the Niagara; and if the speed of the ship was greater than any iron-clad, this gun would enable us to defeat all the iron-clads in the world. The gun is susceptible of such adaptation by increasing the size of the chamber, and

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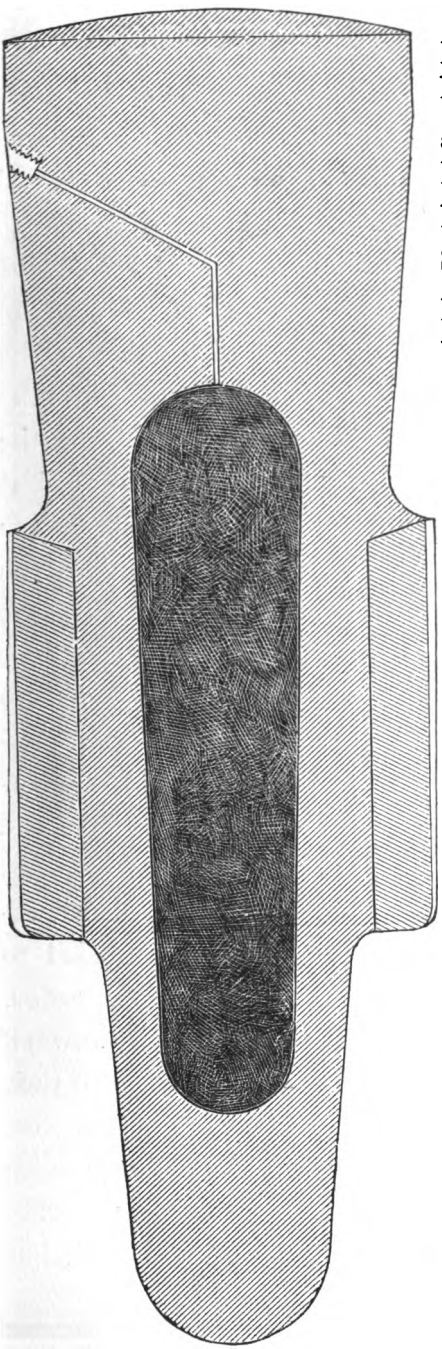

proportionately the length of bore, as to give THE HIGHEST POSSIBLE VELOCITY TO THE SHOT; and, by the principle of compensation, can be made of any required size practicable to be carried on a ship with PERFECT IMMUNITY FROM BURSTING. By placing the nut of the elevating screw on a spring, the muzzle of the gun can conform to the direction of the shot as it passes along the bore, without breaking off the muzzle, heretofore shown to be a fault of guns as ordinarily mounted.

When a shot is projected against iron plates from a rifled gun, it is reduced in

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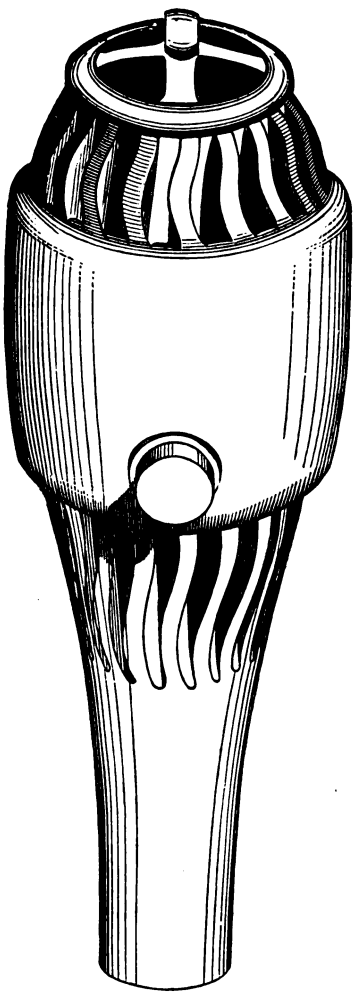
length and enlarged in diameter, so that it would fasten in the hole it had made in the plate. The shot here shown* in section is constructed with its largest diameter at the front end, and the main body tapers toward the rear end, except at the place where a sharp edged collar is placed to prevent a soft metal band from being



forced out of the gun in advance of the shot. The soft metal band will take the grooves and give the shot the rifled motion, but will not hinder the shot in its passage through iron plating, against which it is projected. When used as a shell, it is intended to ignite the powder it contains by the heat of compression resulting from the blow against the plating. The small inclined and inclosed tube is intended to contain common powder, and it is inclined toward the front of the shell that the compression may not entirely close the passage to the powder contained in the cavity of the shell, but rather only close its front end first.

* See page 93.

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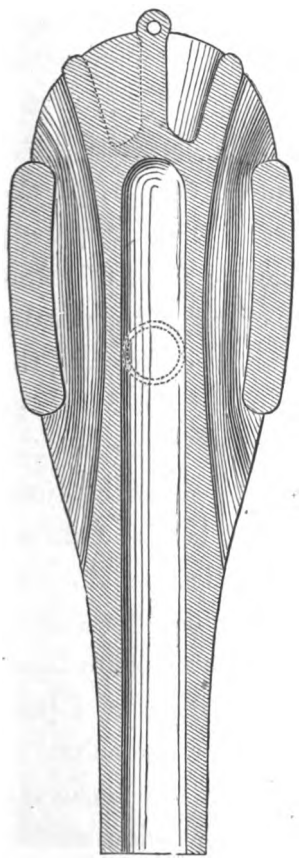
The last gun I shall describe,* exhibits the result of my efforts to produce a cheaper gun of large size than has been before produced, constructed however, with full knowledge of all the effects of combustion of the powder, as laid down by ordnance officers in books heretofore, and discovered by myself. In this gun I provide strength to resist the pressure of the powder, while I compensate for the effects of heat, by superior elasticity, not only for the unequal expansion in the direction of the diameter, but of length also. The gun is to be cast so near to the required dimensions as to need no boring or turning, thus preserving the most enduring surface to the bore, and allowing it to compensate by increased elasticity effectively for unequal heat in its inner and outer portions when made of one metal, as homogeneous cast iron. The Figures are a longitudinal section anda cross section of a gun constructed according to this invention. The passages are cast with cores to leave webs in the doubly curved form represented. The cores between the webs, as also a core forming the bore,



* See page 94.

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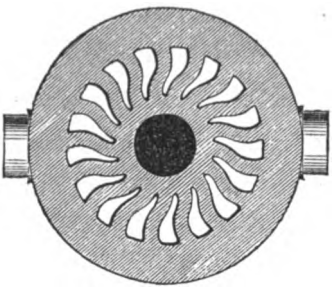
may be cooled by tubes containing water or other cooling agent, in the manner patented by Captain Rodman, if preferred. When the gun is fired, the heat communicated to the interior surface expands the central portions of the casting. The open condition of the iron intermediate between the inner portion *b* and the exterior portion b^1 of the thick part or re-enforce of the gun, allows this portion of the structure to yield by its elasticity, both laterally and longitudinally, far more than when the gun is cast solid; so that the strain, whether purely mechanical, *i. e.*, due to the expansive force of gases, or due to the heat of the interior, or, as will generally be the case, due partly to both, is allowed for, first, the pressure by the strength of the re-enforce; second, the expansion due to heat, by the elasticity of the webs. The re-enforce being cast of a somewhat greater thickness than other parts of the gun, will cool last, and shrink to the required pressure against the webs, and through them upon the inner metal. I can furnish these guns for five cents per pound, there being no machine labor necessary upon them except drilling the vent. I propose to cast the bore so near the proper size as not to require boring, and thus leave about the bore the most enduring surface. The gun, too, being cooled from so much surface, will be of a more uniform structure than has been before attained.



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I am a manufacturer, not a patent-right peddler. Whatever facility of adaptation I may exhibit, is directly devoted to arranging plans for the purpose of making proposals for the manufacture of the work designed, in a practical manner with a view to that end only. I have no sympathies in common with those inventors who value their abstract ideas at millions of dollars, who secure patent-rights for trifles, and who exhibit their principal ingenuity and industry in obtaining money for what is often represented to be "only a lucky idea." My designs are the result of long study and close application, assisted by a long practical experience in constructing machinery and working metals. Whenever exhibited, these plans have received a hearty approval from practical men, and have only been discouraged in the Bureaus of the Government where those having control are wedded to old systems, or where they interfere with patent-rights of incumbents.

I have specified three general plans for the fabrication of large guns, adapted to the various requirements of service. The spherical gun and turret will answer as well for an iron clad ship as a ram, although the weight of the gun and the thickness of the turret are greater than those heretofore proposed, the smaller diameter of the turret enables me to construct it to have no greater whole weight than the Erricson turret with its guns; and when so constructed, it is a smaller object to be aimed at by the enemy's guns. The

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lightest of its projectiles—the one with the hollow rear—weighs 780 lbs. When this shot is used, the cubical contents of the bore and the hollow base of the shot is about six times the cubical capacity of 60 lbs. of fine powder, and that charge would thus be well utilized, giving a respectable velocity to the greater weight of projectile than has ever before been thrown. No ship can be made to carry plating that will resist it, except that its size is so great that it can not enter any of our harbors.

These guns adapted to such tremendous projectiles, can then be mounted in turrets of such thickness of iron as to resist projectiles from any other gun now made, or to be made, if the turret rests on a solid foundation, as in the fort proposed for harbors; and will afford absolute protection to our harbors, without involving extravagant cost of either money or material. The accelerating gun described is available for fast wooden or iron steamships, and, from the extraordinary velocity they afford to the projectile, will penetrate iron clad ships at ranges that are greater than other guns.

The cheap cast iron gun completes the list, and is available for other requirements of service, for which large calibres are required, and as the principles involved in my statements in the beginning of these pages, as I have stated, only affect large guns, I shall discuss the subject of small guns in other pamphlets.

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ON A MEANS OF RELIEVING

THE

Manufacturers of Material of War

INCREASING THE REVENUE,

AND

REDUCING THE EXPENSES OF THE GOVERNMENT.

By NORMAN WIARD.

WASHINGTON:
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1865.

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On a Means of Relieving Manufacturers

OF

MATERIAL OF WAR.

Exportation of Arms.

When this war was forced upon the country it is well known we were without preparation. We had no navy commensurate with the necessities of the emergency; no small arms, and but limited facilities for their production; but little skilled labor, no field or siege artillery, and but a small supply of ordnance; and when it became necessary to build iron-clads, no preparation either to produce the iron or build the ships.

It would seem natural that the War and Navy Departments, from the reputation of our manufacturers for energy, ingenuity, and skill, would have turned to them for assistance, and relied with confidence upon them for the rapid and efficient supply of nearly all the necessary material of war. On the contrary, their first thought was the quickest way to procure what was required from foreign countries; and very early in 1861, General Ripley, then Chief of Ordnance, recommended what was considered a large purchase of artillery and small arms from Europe. General

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Tyler was despatched on a purchasing mission to procure artillery and small arms from manufacturers in England, who were not as well prepared to furnish them as many at home. The Hon. Secretary of the Navy advocated the purchase of iron-clad ships of war and naval supplies from England, without once referring to the possibility of procuring them at home, except appropriations were made to organize navy yards and Government foundries for their production, which appropriations he has continued to ask of Congress on every occasion since, ignoring altogether the private contractors who have produced a great navy, wonderful for the number of its ships, if from no other peculiarity, in an incredibly short time.

The War Ordnance Department seemed determined to see no way to procure small arms, except by the purchase of those of a worthless character from Europe, not even at that time, by making necessary additions to the Government arsenal at Springfield, to furnish the supply, and did proceed blindly to purchase foreign arms by the hundreds of thousands, of which it was said by the commissioners to examine about the purchase of arms, that those purchased "WOULD NOT OUTLAST A SINGLE CAMPAIGN, AND WERE UNFIT TO BE PLACED IN THE HANDS OF CIVILIZED TROOPS." This fatal policy held until in 1862, when so many liberal proposals being made for the manufacture of arms, equal in quality and uniform with the Springfield musket, the then Secretary of War, Gen. Cameron, ordered the closing of contracts with a number of those who had made proposals, which order General Ripley, obeying reluctantly, surrounded with

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the most stringent conditions, notwithstanding which the manufacturers commenced on so grand a scale that forty millions of capital has since been invested, and near twenty thousand mechanics have been educated to the business.

In a report by General Ripley in 1861, it is stated that Springfield muskets cost $13.85 at the Springfield armory. This estimate did not include any interest for investment, or any cost of superintendence or inspection, so far as performed by United States military officers, and it is believed no expense for keeping accounts, or for rejected parts that did not make part of a completed musket; and at the time this estimate was made the United States Government paid all accounts in gold. In view of the heavy investment for plant and material necessary to be used by those beginning *de novo* to produce Springfield muskets, twenty dollars each was fixed as the contract price of muskets under these new contracts, but even at that price no one would have taken a contract for a small number of muskets, for the investment necessary to put one establishment into complete running order to produce muskets at all, has been found to be about $750,000, and to require at least eighteen months of time, and but few of those who undertook to make muskets have delivered their first thousand in even that time. Among the stringent rules of inspection referred to above, inaugurated by General Ripley, was an inspection by gauges measuring each part in every direction of its dimensions to thousanths of an inch, for a universal exchange of parts of all muskets wherever made; and an examination of the texture of the metal in such

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a critical manner that a microscope would be necessary to an unpracticed eye to detect the defect for which parts were rejected An example, that might be termed an oppression, occurred under my own observation, when a proprietor of an arms factory was exhibiting to me 10,000 butt plates of muskets that had been rejected, which I found by referring to the inspector had been rejected on account of some minute black specks on the polished surface that I could not see with the naked eye, but was able to detect with a Coddington lens. In this same establishment, out of 26,000 muskets, 10,000 were rejected for defects not affecting the efficiency of the guns. These of necessity must be either sold to State authorities, from which source the demand has always been small, or kept on hand; and the injustice will appear more glaring to those who know that the Ordnance Department bought and paid for some hundreds of thousands of Enfield rifles during the years 1861, '62 and '63, upon no other inspection than an examination by the eye, cocking and snapping the lock, drawing and returning the ramrod, and fixing and unfixing the bayonet. The barrels were browned and oiled and had been proved in an English Government proving-house, and had the official mark, as all guns manufactured in England have, where it is a felony to offer guns for sale not proved and thus officially marked. This system of purchasing guns from foreign countries held and was well known at the time the contracts for the Springfield muskets were made in this country, and had the effect to give confidence that our Government would deal as liberally with manufacturers at home as with importers of foreign manufactures;

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and although they have been disappointed in this expectation, the manufacturers of arms under these contracts have not complained, as they might, of what seemed injudicious favoritism. Mechanics and manufacturers as a class are earnest, practically loyal men, and will suffer, patiently, much personal hardship to promote the general good.

About July, 1864, the establishments engaged in the manufacture of arms, taken as a whole, might be said to be completed and already producing muskets successfully. Their workmen having then just completed their education—having worked for two years or more, earning reduced wages—were hopeful for the future and proud of their skill. By long, patient and expensive effort, the machinery had become adjusted to the work; and, nothwithstanding the rise in the price of material and labor, the reduction in the value of Government securities, and the long delays of payment, arms were being produced at a profit that began to promise returns for the heavy investments, when a new and utterly ruinous complication surrounds them. A new Chief of Ordnance coming into the place, it is discovered that it is his policy to discourage the manufacture of arms by private factories, and, at the same time, it is noticed that extensive additions are being made to the Springfield Armory, with the evident intention of increasing its capacity to the extent of being able to completely supply the Government, and completely ignore the private factories.

The extraordinary home demand for arms of the past two years, the profusion of currency and a high tariff, had, while these factories were being organized,

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stimulated the enterprise and capital to invest, which, together with the ingenuity and industry of our citizens, was ready to give us a high position. The time has arrived when, by proper encouragement from our own Government and proper legislation, we may become the manufacturers of arms, and, in fact, of all kinds of material of war, to the whole world—for our private arms factories can now afford to sell Springfield muskets for ten dollars each, in gold, and all other arms in the same proportion. But the Government prohibits the exportation of arms and now refuse to purchase more themselves. What can these men do to help themselves? Their whole credit and capital is in this business. They have large stocks of finished and unfinished guns, a large quantity of material on hand, and a force of workmen dependent on them for their daily bread, and no customer for their products, under the War Department rules prohibiting the exportation of arms.

Our ship-yards, iron-works, rolling-mills, foundries, and machine shops, are all suddenly idle, for the Navy Department also has ceased to buy or contract for iron-clad or other ships of war, and the Quartermaster's Department buys old and condemned tubs in preference to new ships or steamers adapted to its use. In fact, the whole manufacturing interest of the country is on the point of being ruined, and it is to be feared a commercial panic will be inaugurated, like that of 1857, the effect of which is fearful to contemplate.

If all the farmers in the United States growing wheat, corn, pork, beef, or horses, equally contraband

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of war with the products of the above named manufacturers, should first be prohibited from selling their products to any other customer than the United States, by an order of the Commander-in-Chief of the Army and Naval forces, and afterwards be informed by the Secretary of War that it was the intention of the Government to produce all these products by the labor of contrabands on Hilton Head and Roanoke Island, and not purchase at all from the farmers—the first mentioned order being still in force—this would be a case of no greater hardship than the mechanics and manufacturers under consideration are now suffering.

Our natural resources of iron, copper, lead, coal and lumber, and the inventive genius, industry and skill of our artizans, gives us, as a people, a high position. These advantages may be entirely counteracted by an injudicious order by the military authorities, having the effect to prostrate the whole manufacturing and commercial interests of the country; or, by careful legislation, these great interests may be fostered, without detriment to the military position.

The time has come when we may manufacture arms and ships of war for the whole world, and it is obvious that the cost of the war will be reduced by the same means that gives us better ability to pay it; for an increased exportation of manufactured articles, for which we can obtain gold, will put our exchanges on a more favorable basis, reducing the price of gold and consequently the cost of every thing else, and the internal revenue receipts will be much greater if manufactures are encouraged.

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There is now a foreign demand for arms, ships, guns, &c., for nations at peace with us and all other nations. Our manufactories can furnish them of better quality and at lower price than they can be otherwise obtained.

If a commissioner were appointed to reside in New York, or one for each great sea-port, to whom all transactions or sales of articles contraband of war should be reported, whose approval should be necessary to a legal sale or clearance, the difficulty would be obviated. A law should be passed removing the restrictions or prohibitions to export arms, ships of war, ordnance, and ordnance stores, except powder and other pyrotechnics, shot, percussion caps, bullets, or projectiles; provided each sale for exportation is made *bona fide* to a recognized government at peace with us and all other nations, and the facts certified to by the minister or consul of such nation accredited to the United States Government, and reported to the commissioner.

To facilitate the sale of arms to foreign governments, an official proving-house should be established by the United States, where all arms should be presented for inspection; pending which, the present force of inspectors should continue to inspect all arms manufactured in the present factories lately producing arms for the Government, and such arms should receive an official mark, dividing them into three classes:

First class to be Springfield muskets, same as for United States service.

Second class: a Springfield musket having a slight defect not affecting its efficiency.

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Third class: all other arms, breech-loaders, carbines, and revolvers, made under patents in which only the powder proof is applied to the barrel or chamber.

It is due to that earnest and loyal class of people, the manufacturers, who have, from their zeal, invested their whole capital and energy in efforts to produce arms, ships and guns for the Government at the time of their greatest need, that they should now have relief from ruin by legislation. At present their works are stopped, their workmen out of employment, the cost of living high, and the prospect before them just this: that their machinery must be sold at auction, when no one wants to buy, but all to sell, and their establishments broken up that have been prepared by a long course of patient industry. The Government cannot afford to have these works and this skill diverted, for who knows what complications may surround us; even if this war were over, we should not chose to be again unprepared. Then let us so legislate as to make other nations support our means for the production of the material of war until we are again obliged to revert to them as the best means of safety.

Thus will the national wealth be much increased; the prospect of future wars much diminished; and when, in the future, if we should have war forced upon us, we will not be found unprepared.

WASHINGTON, *Jan.* 1865.

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MEMORIAL

OF

NORMAN WIARD,

TO THE

Senate and House of Representatives,

IN CONGRESS ASSEMBLED.

TO BE ACCOMPANIED BY

EIGHT PAMPHLETS,

ENTITLED

I.—GREAT GUNS, THE CAUSE OF THEIR FAILURE, AND THE TRUE METHOD OF CONSTRUCTING THEM.
II.—FIELD ARTILLERY.
III.—MARINE ARTILLERY.
IV.—SMALL ARMS.
V.—SHIPS, RAMS, AND FORTS.
VI.—PROPOSALS.
VII.—EXPERIENCES OF A CONTRACTOR, WITH REMARKS ON THE MANAGEMENT OF THE ARMY ORDNANCE BUREAU, AND ITS EFFECT ON THE CONDUCT OF THE WAR.
VIII.—REVIEW, IN DETAIL, OF THE ANNUAL REPORT OF THE CHIEF OF THE NAVY ORDNANCE BUREAU, 1862,

With remarks on the present organization of the Washington Navy Yard, and its uses in connection with the said Bureau.

New York:
HOLMAN, PRINTER, CORNER OF CENTRE AND WHITE STREETS.
1863.

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Entered according to Act of Congress in the year 1863, by NORMAN WIARD, in the Clerk's Office of the District Court of the United States for the Southern District of New York.

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PREFACE TO SECOND EDITION.

THE publication of my Memorial and Resolutions of inquiry, addressed to the Senate of the United States assembled at Washington, together with the accompanying pamphlets, has created so deep a feeling of interest and curiosity in all circles, that I feel compelled, in order to meet the urgent and repeated demand for copies, especially from members of the press and officers of the army and navy, to publish a second edition.

It may be urged as an objection by some, that while my Memorial is replete with charges of a very grave character against officials in high positions, the proofs which should sustain such accusations are too few and insufficient.

I propose, therefore, in the Second Edition, to prove, by personal and other examples, all that neglect of duty, that disregard of the public interests, that pride of place, which ignores all outside intellect and enterprise and the rights of private citizens having business with the Government, and that incapacity which clings to worn-out theories, on the principle

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that it is better to "bear the ills we have, than fly to others that we know not of"—I propose to prove all this in the pages which follow, by reference to the arguments in the pamphlets, and by facts confirmatory of my assertions.

This Memorial and the accompanying pamphlets were commenced on the 15th of Febfuary, 1863, I having at that time become fully satisfied that it was the settled policy of the Ordnance Bureaux, to procrastinate and to put off all action and fulfillment of promises made in relation to my discoveries, and plans, as well as in relation to the settlement of my just claims for service rendered and accepted, until after the adjournment of Congress. Having arrived at this conclusion, I determined to appeal directly to the Senate of the United States for a hearing and an examination of my claims, and to ask for the justice that was unnecessarily delayed, if not absolutely denied me, by those departments.

From delays in the payment of claims, and from the large expenses thus made necessary, and from the depreciation in the value of Government currency between the time of the delivery of articles contracted for and the time of payment therefor—often amounting to a year or more, and always to several months—I have been subjected to a loss of not less than twenty thousand dollars directly, and a much larger sum indirectly.

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Special instances will be found in the statements which are annexed hereto, following the resolutions of inquiry in the order of their bearing upon the same. These statements, together with those to be found in the various pamphlets which accompany my Memorial, will go far to demonstrate the necessity for a thorough and searching inquiry into the management of the Ordnance Departments, under the general supervision of the Secretaries to whom the Resolutions of inquiry are addressed.

I would call special attention to the failure of the Naval Ordnance Bureau to make large rifled guns, described in my pamphlet on Great Guns, pages 11, 12, and 13.

NORMAN WIARD.

New York, March 6, 1863.

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MEMORIAL OF NORMAN WIARD.

To the Honorable the Senate of the United States assembled at Washington, February, 1863.

Having expended much time, money and effort, vainly, in the endeavor to secure from the War or Navy Departments, or either of the Bureaux thereof, official attention to, or examination of, certain discoveries made by me, in relation to the cause of the bursting of large guns* namely: *The unequal expansion*

* See Wiards' Pamphlet, "Great Guns," pages 19, 44, 66. It is often noticed as a curious phenomenon, when large guns burst, that notwithstanding the chase or forward part of the gun, several feet in length, may be thrown many feet, end over end, the shot passes through the chase the length of the bore without being diverted from, or affecting the direction of its aim. This fact corroborates the theory I have advanced.

In speaking of the effect on plates, 5½ inches thick backed by teak, of the 150 pdr. smooth-bore, Armstrong gun, at Shoeburyness; the Mechanics' Magazine says of the 4th round: "Large pieces of the armor plate were driven through the target, crushing the wood backing to shreds, bursting a great opening through the skin plates, and completely smashing two iron frames.

"The discharge of this shot brought the destructive action of the 150 lbs. to a close, for this COLLOSSAL 12 TON GUN, about which there has been so much controversy, BURST IN FIRING THE FOURTH ROUND. The entire breech end, weighing about 17 cwt., was blown off, and carried about 50 yards behind. NO PERSON WAS INJURED. But this is not surprising, because previous to every discharge, the artillery men gave the dangerous monster a wide berth (this would not be so easily accomplished in a turret on board a ship,) the gun being fired by a long lanyard, pulled by a gunner, who was safely ensconced." The London Engineer says: "this gun was broken by a 50 lb. charge after it had been fired with a 90 lb. charge, and this gun weighing 12 tons, ⅛ heavier for the same weight of shot than the Dahlgren of same calibre, and made in the most careful manner, of a material having three times the tensile strength, is burst at the fourth round."

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of the metal of guns by heat, resulting from the combustion of gunpowder in the chamber of the guns, thus involving the necessity for constructing guns so as to secure compensation for this cause, by using metals of different expansibility, as set forth in my pamphlet entitled "Great Guns;" and to certain mechanical combinations, inventions and improvements, essential to the fabrication of trustworthy guns, rifled and smooth-bore of various calibres, to project shot of greater weight at higher velocities than have heretofore been brought into service or deemed possible; improvements in projectiles; to an improved system of Field Artillery; to a system of Marine Artillery, in which guns mounted on light draft steamboats, can be made more available for service on board the boats, in launches, and on shore and to improvements in iron-clad ships and fortification.

I have under these circumstances, finally found it necessary to address myself to your Honorable Body, as every loyal American citizen may do, and to ask that a suitable commission be appointed to examine into, and report upon, discoveries and inventions, which are fully set forth and detailed in the pamphlets which accompany this Memorial.

Our neighbors, the Canadians, have or had a "Board of Public Works," who, when a public building, canal, road, or fort is required, advertise in the papers for "*plans, specifications, and estimates,*" offering five grades of prices as prizes for them. The first being a magnificent price for the labor and genius of producing. The second a liberal price; the third a fair price; the fourth a low price; and the fifth such a price as is supposed to just cover the expenditure for stationery, etc., of the person offering it. These prizes are awarded by the Board, who may call in the assistance of experts to assist them. This Board of Works reserves the right to unite the good qualities of all the matter presented, and to award the superintendence of the work to any of the applicants, or not, as it may decide. A careful revision of these proposed plans and specifications

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It is well known that in all experimental trials of our large guns, the gunners stand at a respectful distance, from fifty to two hundred feet off. Even the inventor and founder will not trust himself within the possible reach of danger, so little confidence has he in the strength and durability of his work.

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takes place, and all the plans offered are carefully recorded. Then other advertisements are inserted for tenders for the construction according to the plans, specifications, and estimates so resolved upon. By this means the best talent of the country, in the various departments, is secured to the Government.

With *certain exceptions*, my plans have been examined by hundreds of officers of the Army and Navy, by members of both houses of Congress, and by numbers of mechanics and scientific experts, and have received the highest unofficial commendation and indorsement. The exceptions alluded to above, comprised those points of my inventions, which I myself, and a few discreet friends of the Government to whom I showed them, judged from patriotic motives, ought to be kept secret. *These I have been willing and most anxious to disclose to the properly accredited agents of the Government, and if need be, to give to my country the entire benefit of all my improvements and discoveries, with any personal supervision necessary to their prompt and perfect development.* Nevertheless, I have found it utterly impossible to command the *slightest attention, recognition, encouragement, justice, or even common civility, at the hands of the Chief of the Bureau of Ordnance of the War Department, Brig. Gen. JAMES W. RIPLEY,* who has to me at all times acted the part*

* On one occasion I received notice that a requisition for additional stores for the Marine Artillery in service in North Carolina had been handed to Gen. Ripley, which were needed immediately, and must, of necessity, be supplied by me. I was in Washington at the time, and I had the stores there, ready for prompt delivery. These stores could not be procured from any person other than myself, and I called upon Gen. Ripley to say I was informed he had a requisition for me, and that if it were handed me there I could supply it from the stores I had in Washington. He very ill-naturedly told me that the requisition had been mailed to me at New York. I asked him for a copy of it, which he refused. As I was leaving the office, I asked a clerk when the requsition was mailed, and he exhibited it to me in his hand, *not mailed*. I returned to Gen. Ripley and endeavored to explain this to him, but in effect he refused to hear me, and asserted that if it had not already gone it would be sent to New York. I immediately applied to the Secretary of War, and he directed that the requisition should be given to me. I received the requisition and supplied the stores on the same afternoon. Had I not thus promptly procured this order from the Secretary of War, Gen. Ripley's rude and unbusiness-like conduct would have caused a delay of several days in the furnishing of stores which were needed immediately, and would have added the unnecessary cost of transportation to and from New York.

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of a morose, illiberal, insolent, arbitrary, and petty oppressor, and in the case of my improvements in ordnance, notwithstanding I had expended more than twenty thousand dollars in making experiments, and in preparing models, drawings, and specifications, and exhibiting them publicly for five months at my parlors at Willard's Hotel, a place of almost daily resort for him during the whole of that period, he could never be induced even to look at them, though often invited and urged by myself and others to do so, but used his influence so far as the expression of his opinion could do it, to discourage and crush me out; and this too, while I was receiving visits from the President, members of the Cabinet, foreign ministers, and commanders of armies in the field, all of whom gave me the most cordial recognition and attention. Neither could I induce the Chief of the Bureau of Construction, MR. LENTHALL, to look at or examine my costly, novel, and much commended models and plans for iron-clad ships, nor could the late, nor the present Chief of the Ordnance Bureau of the Navy Department, *Admiral* DAHLGREN, be induced to even look at my plans and models, with the single exception of a brief call, made after repeated invitations, delays, and one very decided and uncourteous refusal, when, after inviting me to bring some of my illustrations to his office in the Washington Navy Yard, which I did, he refused to look at them, or to hear my explanation upon *any terms*, saying to me petulantly and insolently, that there was "*no use in my trying to explain, as all I might say on the subject would go into one ear and out at the other.*"

Soon after this refusal, the Secretary of the Navy called on me, and in the course of my explanation of my plans to him, he asked me "if Dahlgren had seen my plans and heard my explanations," a question which had often been asked of me before by the President and others. I informed the Secretary of the unofficer-like conduct of his present Chief of the Navy Ordnance Bureau. Previous to the close of our conversation, the Secretary stated that my "explanations of my plans had made a very favorable impression on his mind, and that he would soon send a proper Ordnance Officer to examine and report upon them," remarking incidentally in conclusion, "that it

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would be best to avoid a collision with Dahlgren, if possible, as he was very influential and had a great reputation."

Soon after this promise was made, I was surprised one evening by a visit, apparently voluntary, friendly, and unofficial, from Commander Dahlgren, who informed me that he wished to examine my plans and hear my explanations of them. To this request I assented, making however, one condition, namely, that he should hear me through in a more patient spirit than he exhibited when I called on him at his own office and at his request, and that he should frankly express to me his assent to, or dissent from, my positions as I explained them, or, in any event, *before giving them expression to any other person.*

I supposed he accepted this condition, as he, with apparent cordiality, remarked "Let us have the explanations." During our interview of an hour or more, *no word of assent or dissent was uttered by Commander Dahlgren, except at the points where my arguments were contrary to the theories of Captain Rodman, of the Army Ordnance Department, when he perfectly assented to, and even aided in strengthening my positions.* From the close of that interview to the present time, I have never been able to obtain directly a single word indicating his opinion for or against my plans in relation to ordnance.* Within a week after our interview, however, I was informed that Admiral Dahlgren, in reply to a question from a distinguished Major-General commanding in the field, who had just examined my

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* Yet, since that interview, Admiral Dahlgren, as chief of the Navy Ordnance Bureau, has made a very elaborate, detailed, and specious report, on ordnance and cognate matters, to the Secretary of the Navy, in which occurs, on the 13th page, the following indirect thrust at my theory of the cause of the failure of large guns, namely, *unequal expansion by heat, resulting from the combustion of gunpowder in the chamber of the gun.* It is in these words: "*On another occasion an* 11*-inch gun was fired five hundred times, of which one hundred and seventy fires per day were made in two successive days, which so heated the gun that it was found to be warm eighteen hours afterward. No sign of weakness was detected.*" This paragraph stands alone, without connection or reference, and is remarkable for the palpable design of its author to mislead the reader, as there is no mention made of the amount of powder used, or the weight of shot, nor the elevation of the gun, nor the rate in time of the firing. The service charge fixed by Captain Dahlgren for his 11-inch gun at this time was fifteen pounds of powder—less than half a proper charge.

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plans and was desirous of learning his opinion, said: "*Wiard's plans are contrary to science and the results of all experience.*"

At the close of the last Session of Congress, I called with Senator J. R. Doolittle, of Wisconsin, upon the Secretary of the Navy, and urged my claims for attention and action on his part. The Secretary, after some hesitation, at the direct request of Senator Doolittle, sent for the then, and at present Assistant Chief of the Ordnance Bureau, and asked his opinion of my plans, for a "turret and spherical guns." That officer promptly replied that *he had examined my plans and had heard my explanations repeatedly, and fully understood and approved of them; stating further that if he could have his own way, he would direct Mr. Wiard to build a turret and a pair of his guns at once.* Upon this statement the Secretary expressed himself satisfied, and promised to appoint a Commission, consisting of Admiral Gregory, Lieutenant Wise, and Chief Engineer Stimers, as suggested by me, among others, as suitable officers to act. I left the Secretary with the understanding that when I was ready, I was to notify him in writing, and the Commission would be immediately directed to meet me in New York City.

A short time after, I notified the Secretary that I was ready, but neither that notification, nor subsequent application, resulted in procuring the Commission promised. Many months have passed away and I am, apparently, as far from getting the promised examination as before.

I recently submitted my very elaborate and detailed specification and patent drawings, intended for England and France, to the War and Navy Departments, asking for a joint Commission to be appointed to examine, and decide how far the interests of the government would be subserved, by keeping secret some of my inventions, and to examine and report on all of them, to the respective Navy and War Ordnance Bureaux.

I have now made three applications, the third being as above stated, for a *joint* Commission, and the promise has been as often renewed and still no Commission is appointed; and the Secretary, when pressed, now refers the matter to a more convenient season, or to the Chief of his Ordnance Bureau, who declares that he *has no time to attend to such "outside mat-*

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ters," yet, " that he would not put a straw in Mr. Wiard's way, as he will have trouble enough before he gets his plans perfected and adopted."

The War Department had the matter before it for some weeks, but did not even read my very brief written request. The Navy Department, through the action of Captain Henry A. Wise, Assistant Chief of Ordnance, and Captain Fox, Assistant Secretary of the Navy, promptly agreed to appoint its part of the joint Commission, but several weeks have already elapsed, and I have not yet received a notification of the formation of this Commission.

Another reason why I, at this time, urge my Memorial upon the attention of your Honorable Body, is, that it has been noticed with alarm by many of the earnest and patriotic men who watch with anxiety the course of events during this unholy war, that proposals for heavy ordnance are advertised for in the newspapers, but coupled with such oppressive conditions, that only those entirely ignorant of the difficulties which are well known to the Ordnance Department and to ordnance founders, will venture to make a proposal or enter into a contract, (and such men *are not likely to succeed in producing good guns*), the contractor, having to submit to a test, on the result of which the payment for even a single gun and the continuance of his contract is to depend ; this too, although many thousand dollars must be expended in preparation. And this test, as in the case of the 13-inch guns now required, is one to which no 13-inch gun has ever been submitted. And when such parties do undertake such work, a sufficient number o failures are certain to be recorded, that Ordnance Departments can present to your Honorable Body, fallacious arguments why you should make large appropriations for extending the facilities of the old, and building new government founderies, in which old errors are to be perpetuated, and new places found for officers among men of their own class. And a strong point of argument urged upon your Honorable Body in favor of such appropriations, is the failure to secure the fabrication of the required amount or quality of guns or arms from private contractors by this means. And you are urged, almost at the last day of the

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session, to make these appropriations for reasons involving an outrageous shifting of the odium of the want of knowledge and skill, from the persons on whom it should properly rest, in order to unjustly discredit the skill and enterprise of the mechanics of the country, whom it has always been believed were equal to any demands in this direction that might be made upon them, and whose *loyalty* is undoubted.

No better argument can be used in opposition to the proposed appropriation of millions of dollars, for the purpose of establishing great government founderies for the production of cannon, and confirming officers in life-long sinecure positions, than the acknowledged fact that all governments which have trusted to the skill and ingenuity of a privileged class, or to one person to decide upon or to furnish designs and improvements in ordnance, have signally failed, as in the case of England. Sir William Armstrong having, according to computations, cost that government over forty millions of pounds sterling for experiments upon his inventions. Yet his large guns have always failed, while Whitworth, Blakely, and others, private citizens, without government patronage, have succeeded in producing better guns, as might have been expected, since no man so earnestly strives for success as the one who pays his own bills. I might call the attention of your Honorable Body to an illustration nearer home.*

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* A letter addressed to the Secretary of the Navy by me, and which appeared in the *N. Y. Tribune*, will more fully explain my views upon this subject.

GOVERNMENT FOUNDERIES.

To the HON. GIDEON WELLES, *Secretary of the Navy.*

SIR: In reference to your proposition to organize Government founderies for the production of large guns, and to your proposition to Congress to make an appropriation of $30,000,000 for rolling mills and the fabrication of heavy rolled plates for iron-clad ships, etc., I wish to say that your statement and letter to Congress to the effect that "there are but two or three manufactories capable of undertaking such work, and these of limited capacity," creates no little surprise among that class of persons who have been in the habit of thinking that the genius and enterprise of our people is unparalleled, and who can not be brought to believe, by so slight an allusion as you have made to the subject, that there are not hundreds of contractors possessing sufficient skill and commanding sufficient capital to produce, with economy, any required article of

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It is a national disgrace, that a people who justly pride themselves on their mechanical ingenuity and skill, should intrust

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manufacture, through private enterprise, that can be produced by Government employees with an appropriation of four times $30,000,000; and these men will continue to be of the same opinion, even after they have had presented to them all the arguments that were presented to you as an inducement to make an application to Congress so contrary to the true interests of our Government and the spirit of our institutions, and so degrading to our character for skill and enterprise.

With regard to the fabrication of large guns, you undoubtedly know that with all the routine efforts of our ordnance officers, and the millions expended in experiments, we have not yet secured a single trustworthy 80-pdr. rifled cannon, and have utterly failed in our 7½ inch rifles (150 pounds), that we have no regular ordnance officer to-day willing to say that he will fabricate a 50-pdr. rifle and offer it for service with the assertion that he knows it to be a good gun, without having put it to trial. If we have not yet learned how to make a trustworthy gun by the practice of the exclusive system during so many years, and at such an expenditure of time, money, and materials, ought we not to have learned to open the business to public competition, and to bring to the service of the Government the constructive genius of 20,000,000 of people instead of the traditions handed down from one to another of a class of men all educated in the same exclusive school, and only numbering a few hundred individuals in the course of a hundred years.

The late proposition for tenders for large guns, as seen in the advertisements in the newspapers, emanating from yourself and the Secretary of War, would seem at first sight to be a frank permission to outsiders to enter the arena, yet this field of competition may be compared to a prize-ring to which the Ordnance Department challenges all comers, and when the people, eager for a fight, press against the ropes, the Secretary of the Navy acts as umpire, and suggests that three or four of them only be admitted to fight it out, and whip each other in the presence of admiring ordnance officers.

If the Government wants *large guns, and our ordnance officers know how to make them, why not set them to work upon them, and make room for the work in the present ordnance founderies by giving the small guns to outside contractors, furnishing these contractors frankly with all the information that has been obtained at the expense of the people upon the subject?* Pay Capt. Dahlgren a salary predicated upon his success with large guns. I would not ask you to be as severe with him as with any private contractor, for if the ninth or tenth gun of a lot of fifteen, made by a private contractor, made even at a cost of $100,000, should burst, you condemn the whole lot, and the ordnance officers congratulate themselves upon having disposed of one more of those *presumptuous mudsills* who has had the audacity to meddle with what is held to belong exclusively to *government-bred* aristocrats, born to position in the Navy Department.

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the invention and fabrication of so important an auxiliary to their unity, power, and national greatness as Ordnance, wholly

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If even our experienced ordnance officers have doubts about success in making large guns, why advertise for tenders from contractors for furnishing large guns, and in such a manner as to throw all the risk upon the contractor? Was not the real object to get rid of the importunity of those unsophisticated inventors and would-be-contractors who were pressing their claims for contracts upon the Government, but who would be either deterred by the stringent terms, or annihilated by expending their time and means upon an effort to produce an article, in which they have but one chance in a thousand of succeeding, and still less able to serve the Government by giving it a trustworthy large gun. It is a gross outrage upon the people who pay the expenses, that after all the money expended, even Capt. Dahlgren can not give you the plans and specifications for the manufacture of a large gun that will not have to be destroyed to prove its barely tolerable quality. Yet Capt. Dahlgren once stated to me that he "had burst more guns than any other man in the world;" now had even a small per centage of the money thus expended come out of his own pocket, either he would have been ruined or his guns improved. It leaves the impression on my mind that in the advertisement for tenders for large guns, in your letter to Congress relating to appropriations for manufactories for heavy rolled plates, and in the advertisement for tenders for fifteen gunboats, you have put the contractors in a false position. You will not, I know, pay a price for large guns that covers the risk, and I do not believe that any man familiar with the subject believes that you would get the guns even if you did, while you do not know that thick rolled plates are to be the best armor for iron-clad ships, or that there will ever be more than one ship made—the experimental one—and you would not give the contractor a contingent agreement to pay for machinery that would be useless for any other purpose in case you should not require plates for more than one. And you can not expect to get fifteen gunboats to draw six feet water, and attain a speed of sixteen miles an hour. If the contractors work up to their own plans, some of them will fail and all of them are liable to do so. Will you pay any thing for the risk in addition to a fair price for the actual cost? I think not to the contractor, but you will ask for an appropriation to build Government shops, and thus insure that the risk is taken by the Government. But you do not thus insure that you get the most trustworthy guns, the most enduring plates, or the most efficient gunboats. As a rule, it may be depended upon that any investment of this kind that would not be thought desirable by any of our careful business men is not desirable for the Government. Great Government founderies also do this great wrong, that they demoralize our mechanics and paralyze our manufactures. Organize a great ordnance foundery at Chicago, for instance, where now it is the hope of the citizens at some time to attain the dignity of being a manufacturing City. For months after each election, the mechanics hang about the

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to a class of persons who have been educated as theorists. It is as difficult to teach mechanical ingenuity in schools, as it would be to communicate the inspiration of a poet in such places. We have no schools for the specific purpose of making

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corner groceries, drinking bad whisky with loud politicians "laying pipe" to get appointed to the Government shops, where wages are high, hours of labor short, and duties not severe. During this time they can not be induced to take employment at any other manufactory. They spend the money earned by previous economy, while the certainty that but few can be appointed, only spurs them on to greater exertion, and makes them more heartily despise their former employment. When finally employed, their earnings are spent in the same groceries, button-holing friends and preparing for the next election, as the conditions upon which they get the appointment, and the continuance of this habit makes them despise even their employment at the Government shop, and they take up their abode at the before-mentioned bar-rooms, where they sink to the condition of a self-imposed candidate for Congress or some other official position, from which they are seldom or never reclaimed. How universally this is the rule can only be believed by those who have seen it, and it can be seen wherever there is an institution of the kind mentioned. The true policy of the Government would be to have an Ordnance Bureau and Bureau of Construction, not managed by one old and superannuated naval commander, but by a number of men eminent for their intelligence, skill, and integrity, who should advertise for plans and specifications, to be paid for according to their merit, and then let the same bureau advertise for tenders for the furnishing of every article required, made according to the plans and specifications so procured. I would have a board for each of these bureaux, nominated by the President and confirmed by the Senate, each of the bureaux being composed of five members, with one expert as a clerk, to be paid only when on actual duty. The result in guns and ships of war under such a system would shortly excel anything in the world. The Government would obtain whatever it required at the lowest market prices, as would any intelligent business man. We should thus conform to the spirit of our Republican institutions, and could always know the cost of whatever we produced, and we should support and worship no aristocracy but that of talent and genius to which we owe, at least, as much deference as we have been in the habit of paying in *talk*. It has been an-often-repeated remark that this war will develop great improvement in the engines and art of war, but at the same time, fear is expressed that European nations will reap more benefit from it than we shall ourselves, for engineers here, failing to receive attention at home, will be encouraged or compelled to exhibit their inventions and improvements in France, England, and other countries, and their adoption would leave our country far behind. This danger should not be forgotten by our Government, for we may not even have completed our present ungracious

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poets, why then should we expect in such places to create or incite the equally *divine* inspiration of mechanical genius.

We can, and we should adopt a system which would produce guns that would as completely answer the purpose for which they are intended, as our most common agricultural implements answer the end for which they are designed.

What farmer would long continue to purchase ploughs of a manufacturer, whose productions were liable to fly in pieces at any extra strain, while turning a furrow, killing the ploughman, destroying the team, and tearing down buildings.

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task, before we shall be called upon to begin another war of greater magnitude, only to be successfully encountered by a bold front and the most formidable preparations.

NEW YORK, June 25, 1862. A LOYAL MECHANIC.

The *Scientific American*, December 20, 1862, fully indorses my views in an article headed NATIONAL FOUNDERIES:

"To establish national work-shops, is to offer a premium for all sorts of incapables who may have political influence. * * * * Not only can these facts be established, but it is also true, that at a period when the Government required the services of engineers of experience to fill ordinary appointments on the transport, despatch, and iron-clad vessels and batteries, this same political schibboleth presented itself, and became a grevious stumbling block in the way of men who really desired to serve their country. * * * What ante-diluvian systems, and what crab-like progression would be inaugurated in spite of the protests of the mechanical world outside of these fostering government yards. * * * It is not chemerical to assert that favoritism would be the rule. * * * It is hinted that the private establishments can not turn out sufficient work to answer the demands, and also that they can not make as large a class of forgings or castings as might be desirable. These are singular assertion in view of the facts. * * * If there is any especial need for more massive products or better materials than are now furnished, we are much in error. * * * And there is another point which would act materially against the succesful operation of government shops. That is, the contract system properly insisted upon, to guard against fraud or delay. How can there be any guarantee to the public equal to that afforded by the work-shops in the various States, now in full blast night and day. Heavy forfeits are insisted upon from the contractors, both as a spur to them, and as a remuneration to the people in case of non-compliance.

How can a government exact forfeit from itself?

An example of the incompetency of the government to carry on such great undertakings is well attested in the miserable war vessels which it has hitherto built.

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In conclusion, I respectfully ask that your Honorable Body will take such action as may be necessary, by appointing either a special Committee, or a competent Commission, composed of ordnance officers and scientific experts from civil life, to secure a careful and proper examination of, and report upon, my inventions and discoveries, which I claim deserve attention, as they are now a vital subject of inquiry, and should receive examination from such Commission, together with such improvements as may be offered by others, which in the opinion of the Commission are deserving of attention, and which, if developed, would redound to the dignity and power of the nation.

I believe that no man, however autocratic his official or social position; *even though he should be near to the ear of those in high places, and be supported by interested and influential friends and a great name*, should be permitted to hold himself above the right of inquiry on the part of the people into the administration of his public duties, more especially when those duties confer almost unlimited and irresponsible power of expending the public moneys in ways that may be subversive of the public interests; and firm in the belief that there are great wrongs to be righted and stern justice to be done; and as a justification of the course which I conscientiously feel compelled to pursue on behalf of myself and others, who have suffered from the neglect of, or dereliction in the performance of those duties, and to afford an opportunity for defense to those I may have inculpated; I earnestly ask that the following resolutions of inquiry be adopted by your honorable body, in behalf of the interests of all concerned; and in support of my petition, I state the fact that a similar resolution of inquiry addressed to the Secretary of the Navy, was offered by the Hon. Mr. Foulke, of Illinois, in the House of Representatives, and adopted during the last session of Congress, but its intent and meaning were practically evaded by the Ordnance Bureau, and the desired information was not then, nor has it since been furnished by the Secretary of the Navy.

NORMAN WIARD.

136 East 33d Street, New York.

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RESOLUTIONS.

Resolved, That the Secretary of the Navy be, and he is hereby requested to report to and inform the Senate, what rifled cannon of cast-iron, wrought-iron, steel or semi-steel have been projected, designed, or made under the auspices of his department, and by whom ;* also what number, size, weight and cost of cast-iron, wrought-iron, steel or semi-steel blocks have been contracted for or ordered, and how many of the same have been delivered, and by whom and where ;† also, how many of each size have been finished or partly finished, and by whom and where.

Also, how many from any cause or causes have burst or been rendered unserviceable, with the name of the designer or designers in each case,‡ and what expense to the public Treasury has been, or is likely to be incurred in purchasing, transporting, fabricating and experimenting on these blocks.

Also, how many, if any, of each of the various sizes of the Navy "Dahlgren" smooth-bore guns, and of what materials constructed, have been burst or rendered unserviceable at any time during experiments upon them, or while in service, and at what place, or places, and by whom designed and fabricated.§

Also, what expense to the public Treasury has been incurred for any and all such experimental burst or unserviceable "Dahlgren" guns, and what amount for gunpowder and projectiles used in such experimental efforts, and for labor, transportation, and preparation for the proper conducting of the same.

Also, what discoveries, if any, have been made in regard to the cause of bursting, or failure of guns of large calibre, rifle or smooth-bore.‖

Or what improvements, if any, have been made or proposed in materials or the methods of fabricating large guns, rifle or smooth-bore, or to ensure their greater endurance and immunity from bursting, by any naval ordnance officer or officers.¶

And what patents for the same, if any, have been issued, and to whom; and in whose interest and at whose expense.**

Also, what discoveries, inventions, or improvements, patented or otherwise, if any, designed to secure the above stated specific results have been submitted

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* See Wiard's Pamphlet "Great Guns," pp. 10.
† " " " " " 10, 11, 12.
‡ " " " " " 10, 11, 12.
§ " " " " " 11, 12, 13.
‖ " " " " " 18, foot note.
¶ " " " " " 19 to 44.
** " " " " " 8, 9, 10.

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or offered to his department, or the Ordnance Bureau thereof, by unofficial persons,* and if any, what their nature, and by whom.

Also, what action, if any, has been taken by himself or his Chief of Ordnance, to properly examine into their merits and test their practical value, or to secure the exclusive or specific use of any of them for the service of this government.

HISTORY OF MY CONTRACTS WITH THE NAVY DEPARTMENT.

On the last day of July, 1861, I made a proposal to the Navy Ordnance Bureau, to furnish a large number of forged semi-steel small guns. On the next day I received the following answer from the Department.

BUREAU OF ORDNANCE AND HYDROGRAPHY,
Navy Department, Washington City, *August* 1, 1861.

Sir,—In answer to your proposals of yesterday's date, I have to inform you, that, the Bureau being desirous of procuring rifle cannon for the use of the Navy, at the shortest possible notice, will purchase guns of your fabrication of semi-steel; *Provided:*

1. That the guns made shall conform strictly to the directions and drawings herewith presented.

2. If you will offer five guns made as above stipulated, the Bureau will receive them subject to proper inspection, and if accepted, pay you at the rate of eighty-five cents (85c.) per pound.

3. It is to be distinctly understood, that, the Bureau is to be the judge of your compliance with the conditions of the agreement, and binds itself to the purchase of no more than may be ordered from time to time.

You will please notify the Bureau if you accept the terms herein specified.

Very respectfully,
AND'W A. HARWOOD,
Chief of Bureau, Ord. and Hyd.

To Mr. NORMAN WIARD,
Washington, D. C.

I reluctantly accepted these terms, and no complaint has ever been made that I failed, in any particular, to comply with the same to the minutest particulars of workmanship. The guns were made after designs by Capt. Dahlgren, and the fault was not mine, if they were designed upon erroneous principles, as I now know they were, and that too from confessed ignorance on the part of the designer, as to the cause of failure.

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* See Wiard's Pamphlet "Great Guns," pp. 66 to 98.
Also see "Proposals" Pamphlet.

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A week after, on the 7th of August, 1861, I received the following proposition from the Navy Department:

BUREAU OF ORDNANCE AND HYDROGRAPHY,
Navy Department, Washington City, *August* 7, 1861.

Sir,—The Bureau wishes to contract with you to make some semi-steel howitzers, 12-pdr., to be made after a model gun which will be forwarded to you by express.

Will you please notify the Bureau whether you will undertake it.

The guns to be made, subject to such inspection and conditions as are provided for in your other agreement.

Very respectfully, your ob't. serv't,
AND'W A. HARWOOD,
Chief of Bureau.

To NORMAN WIARD, ESQ.,
136 East 33d St., New York.

To this I forwarded the following reply:

WASHINGTON, *August* 9, 1861.

Capt. Andrew A. Harwood, Chief Bureau Ord. and Hyd.. Navy Dept:

Sir,—My visit to New York has resulted in my being able to offer you Steel Rifled Cannon at a price, that is much lower than the prices heretofore proposed on my part, and this reduction has been resolved upon from more favorable arrangements made with parties employed in the business, and from the confidence I have that the exigencies of the service will require a sufficient number of guns, small as well as large, to enable me to keep the founderies exclusively and fully occupied.

For Guns with	23	inches	largest	diameter,	90	cents	per lb.
" " "	20 to 22	"	"	"	80	"	
" " "	16 to 20	"	"	"	65	"	
" " "	9 to 16	"	"	"	55	"	

These prices are for all guns for which I receive orders hereafter; but not to affect the price of the first five guns, for which I now have your order; however, after the completion of the first five, the price will be reduced from eighty-five cents per pound to eighty cents per pound; 12-pdr. howitzers of less diameter than sixteen inches, are now offered you for fifty-five cents per pound.

I wish to have permission to offer a part of the first lot of small guns you may order made of cast-steel (solid ingots). I have made a few of these guns, and I think they have superior qualities. I can furnish them at the same price.

Yours truly,
NORMAN WIARD.

It has been claimed that Admiral Dahlgren has never charged or proposed to charge the Government any thing for the use of his Patents. My experience on this point, which is detailed hereinafter, does not corroborate this claim for dis-

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interestedness on the part of that gentleman. The original drawings made by Dahlgren, and sent to me for the 50-pdrs. I was to make, had the trunnions marked to be *forged* on the body of the gun. To avoid re-entering angles, and to enable me to hammer the guns uniformly, I requested permission to use the recently patented breeching-strap and trunnions of Admiral Dahlgren. This was at first denied me for the reason stated, "that it belonged exclusively to Commander, now Admiral, Dahlgren, and it might interfere with his interest in it, should he wish to dispose of it, at some *future time*, to a foreign government or individuals." It was finally decided, as will be seen by the following letter, that I might be permitted to use this patented breeching-strap method of putting on trunnions.

BUREAU OF ORDNANCE AND HYDROGRAPHY,
Navy Department, Washington City, *August* 12, 1861.

Sir,—I have received your letter of the 9th inst., requesting instructions in reference to putting on the trunnions, sight and lock pieces on the steel guns you have engaged to make.

In reply, the Bureau authorizes you to use the breeching strap plan, contrived by Commander Dahlgren, and wishes you to understand that the welding or forging on the trunnions or other projections is not approved.

The lock lugs and sight masses may be screwed on.

While, as I explained to you, it would be impossible for the Bureau to state the exact number of rifle cannon and howitzers required, I take this opportunity to repeat to you that a large number will be wanted, and, as they are wanted directly, the establishment which can make them quickest and of good quality will necessarily have the most do. The order will be renewed as soon as the Bureau hears from you of the completion of each batch of five of the large guns; *and it will be the same case with regard to the howitzers*, provided you can carry on the work at both, at the same time, without retarding the delivery of the larger guns, which will be most wanted.

Very respectfully, your obedient servant,

To NORMAN WIARD, ESQ.,
136 East 33d St., New York.

AND'W A. HARWOOD,
Chief of Bureau.

On the 28th of August, 1861, I received the following letter, which will be found an important one in the history of this transaction:

BUREAU OF ORDNANCE AND HYDROGRAPHY,
Navy Department, Washington City, *August* 28, 1860.

Sir,—In *assenting to the making of five more steel guns by your establishment*, it was understood between us that the guns made under this new order

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are to be paid for according to the reduced rates proposed by you, namely, 80 cents per lb.

I must also remark that the reception of these guns depends necessarily upon the proof, and therefore any expedition which may seem desirable to the manufacturers is entirely at their own risk.

Very respectfully,

MR. NORMAN WIARD, 136 East 33d St., New York.

AND'W A. HARWOOD, *Chief of Bureau.*

The following letter was received by me in answer to a proposal made by me to the Department, to finish large cast-iron Navy guns, the blocks to be furnished by the Department:

BUREAU OF ORDNANCE AND HYDROGRAPHY,
Navy Department, Washington City, *October* 18, 1861.

Sir,—1. The Bureau *accepts* the trial gun recently fired by the Inspector of Ordnance, and *you are requested to complete the remaining* 50-*pdrs. with all possible dispatch.*

2. *As soon as the guns are inspected and proved, they are to be delivered at the New York Navy Yard.*

3. With reference to your proposition for finishing VII½ inch rifles and XI inch shell guns from rough castings, the Bureau will authorize Commander Hitchcock to make whatever arrangements he may deem expedient, in view of carrying out the interests of the Government, and he will likewise be directed to communicate with you on the subject.

Very respectfully,

AND'W A. HARWOOD,
Chief Bureau Ord. and Hyd.

MR. NORMAN WIARD,
136 E. 33d Street, New York.

Thus, it will be seen that I had a contract with the Navy Department to make 50-pdr. semi-steel rifle guns. I received an order for five, at 85 cents per pound, and after the proving of a trial gun, one of the first five, which was accepted and paid for, *I received an order for five more.* These guns were to be constructed on the same models as the Navy cast-iron 50-pdr. rifles, the drawings being furnished by Capt. Dahlgren, through the Bureau of Ordnance, to me.

I made ten forgings, and finished seven guns, of which five were absolutely perfect, notwithstanding it was supposed that it was impossible to manufacture solid masses of steel in this country of the great weight required, viz., 7,800 lbs. One of these guns was put to extreme test, and was decided by Inspector Hitchcock to be unusually satisfactory. This gun was accepted and delivered and paid for.

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The balance of the "*first five were ordered to be completed and delivered with the utmost despatch.*" Two of them were completed, inspected, and submitted to a test of *ten rounds, the contract condition*, and delivered at the Brooklyn Navy Yard, where they have remained ever since *not* paid for. Two others were measured with the star gauge, inspected and made ready for firing, and are still in the Foundery, the inspection and test uncompleted, ready for instant delivery. Two more were submitted for inspection and test of firing. One of them burst on the tenth round, it having been fired very rapidly on a cold gusty day, but was found to be perfectly homogeneous and solid. The tensile strength of the metal of all these guns was four times that of any cast-iron gun. The other, which from the great anxiety of the Bureau to have the guns before new machinery for boring and turning could be constructed, was finished at a work-shop in Brooklyn, and the workmen engaged on it committed a fraud, by inserting a false chamber, to supply a defect caused by boring the block about two inches too deep. This gun was fired very rapidly on a cold day, and burst at the ninth round, disclosing the fraud above-mentioned, with which I had nothing to do, as the Navy Department has undoubted proofs from its Ordnance Inspector, Hitchcock. The following extract from Com. R. B. Hitchcock's letter to the Navy Department, dated, December 13, 1861, shows that he entirely exonerates me from any complicity in the transaction:

"From all that I can ascertain, this gun was bored at one establishment, and then sent to another to be turned; by mistake, too much was turned off from the breech; this false piece* was then inserted, to bring the bore forward into its proper position.

* This plug was taken out and sent to the Ordnance Bureau by Inspector Hitchcock; from thence Captain Dahlgren took it to his office at the Navy Yard, where he kept it for exhibition to members of Congress and others likely to be influential in passing a vast appropriation for Government Founderies. On one occasion, as I am reliably informed, the President and Assistant Secretary Watson being present, this unfortunate and inevitable "plug" was brought out by Admiral Dahlgren, and the circumstances in relation to it fully set forth to these distinguished personages with such eloquence, that

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"I have no cause to think that Mr. Wiard had any knowledge of this transaction."

Again, in a letter to the Navy Department, May 17, 1862, Com. Hitchcock writes:

"*I believe Mr. Wiard to have acted in good faith in all his transactions about these guns.*"

Notwithstanding these letters exonerating me, the failure of these guns was made the *excuse for annulling my contract for 50-pdrs., and also my contract for Howitzers.* I had made twelve of these Howitzers for Gen. Burnside, and five for the Navy Department, from a pattern gun sent by the order of the Bureau from the Brooklyn Navy Yard. The five Navy Howitzers passed a rigid inspection, were fired *ten rounds, the contract condition*, and sent to the Navy Department, where they remained for a year unpaid for.*

The twelve Howitzers furnished to Gen. Burnside were for Col. Howard's regiment of Marine Artillery, and proved to be

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the President was induced to remark that, "the man who could be guilty of such an outrageous act, likely to imperil the lives of patriotic sailors, ought to be hung and quartered;" adding, "who was the man who did this thing?" To which Admiral Dahlgren answered in his blandest manner, "Mr. Wiard of New York," making no mention of the facts stated by Captain Hitchcock, completely exculpating me, which he must have known, as the first letter from which the above extract is taken, was sent with the "plug" to the Ordnance Bureau. On learning this fact while in Washington last summer, I charged this attempt to stab me in the back upon Admiral Dahlgren, to which he replied, in substance, that the matter had been brought up before the President as an illustration of the unreliability of private establishments, and to demonstrate the necessity for having great Government establishments, under the immediate supervision of *trustworthy* and *intelligent* Ordnance officers, like himself, as I inferred, responsible to—whom?

This is not the only instance in which Admiral Dahlgren has shown a similar disposition to place me in a false position, where it would be likely to impair my reputation and injure my business prospects.

* I subsequently received payment for these guns, they having been submitted to a re-inspection and testing, and were found perfect, and are now in service. Before they were delivered to the Navy Yard, I applied to the Bureau for permission to give them to Gen. Burnside, on account of the War Department, who was most anxious to have them, the twelve Howitzers previously furnished him by me, having given such entire satisfaction. This permission was peremptorily refused by the Ordnance Bureau, yet the payment for them was delayed for more than a year after their delivery.

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far more enduring and effective than the bronze rifle Howitzers, bearing the name of Dahlgren. See "Marine Artillery" Pamphlet.

While the work of finishing these semi-steel guns was going on, Capt. Andrew A. Harwood, then chief of the Navy Ordnance Bureau, visited my workshops, and examined the finished work, and that in the process of finishing; on which occasion he expressed himself in the most unqualified terms of satisfaction and even admiration, for the perfect and even elegant manner in which every part of the guns was finished—*more than once repeating the remark that "he had never seen any thing at all equal to it, either in a government or a private Foundery, and that he was fully satisfied with all that I was doing."* This visit was made but a few days before the failure of the last of the 50-pdrs. herein-before mentioned.

I found, in measuring the pattern howitzer made at the Washington Navy Yard, *that it had not the accuracy and workmanship which was demanded of me in the most stringent terms, and with which I strictly complied.* The calibre varied at different points along the bore, and the rifling was simply absurd, especially in a bronze gun, it having a twist of one turn in five feet, or twice as much as will be found to be most effective, even in my semi-steel guns, the metal of which has a hardness and an unyielding endurance, in small sizes, that would enable them in service to outwear a dozen such rifle guns made of bronze. These semi-steel guns can be furnished for about the same price as the bronze guns; or, at all events, I am willing to contract to furnish from 100 to 5,000 semi-steel howitzers, navy pattern, rifle or smooth-bore, for the same price as the bronze guns could be furnished for now.

The *annulling of my contract for Howitzers was an act of outrageous injustice,* and was made without cause (no gun of that kind having failed), to my very great injury; the more especially as all of these guns were made with the utmost care, and none of them have ever been found defective, though submitted to the severest service, and their manufacture was conducted under my own eye and in workshops under my absolute control.

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MY CONTRACT FOR FINISHING LARGE CAST-IRON RIFLED GUNS.

I received an order from the Navy Ordnance Bureau to finish fifty 7½-inch, 150-pdr. guns; seven of the blocks were delivered to me, three of which were entirely finished, and the balance were ordered to be returned unfinished, as the various trials at the West Point Foundery and elsewhere demonstrated these guns to be entirely unreliable. The blocks upon which I commenced work were from the Pittsburgh and West Point Founderies, and were of the two qualities, *high* and *low* cast-iron, specially adapted for gun metal, with a tensile strength of from 32,000 to 34,000 lbs. to the square inch.

After much delay, and a very large expenditure for heavy machinery, I was paid the contract price for these seven guns, and the *contract was annulled for no fault of mine.* These numerous failures, to keep faith with me on the part of the Ordnance Bureau, and the acknowledged untrustworthy character of large guns led me to *inquire into the cause of the frequent bursting of guns* and this inquiry resulted in the *discoveries* and the *improvements* to which I have *asked attention in my Memorial.* On the 19th and 25th of July, I submitted two notes involving a proposition, that the Ordnance Bureau should let me have the steel 50-pdr. that had been put to extreme test and two of the 150-pdr. cast-iron guns, on which to try my proposed experiments, as set forth in my pamphlet entitled "Great Guns," page 60. As a part of my proposition, I asked that the actual expenses incurred by the experiments, which I proposed to make exclusively in the interest of the Government should be allowed me by the Bureau, charging nothing for my own services. To this I received the following *liberal* and *patriotic* reply:

BUREAU OF ORDNANCE,
Navy Department, Washington City, *July* 28, 1862.

Sir,—In reply to your notes of the 19th and 25th instants, I have to state that, the 5 and 1-10 inch steel gun made by you, will be placed at your disposal as requested, for the purposes contemplated.

It was never intended, however, to do more than to supply you with the *steel gun* and the *other two guns asked for;* and, therefore, all *other expenses are to be borne by yourself.* I am very respectfully your ob't serv't,

JNO. A. DAHLGREN,
Chief Bureau Ordnance.

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This order is still in force, and I shall call for the guns very soon, and make the proposed experiments and demonstrations at my own expense, which I should have done before now, but for the complications forced upon me by the failure of the Ordnance Department to fulfill its contracts with me.

I presented my bill to the Ordnance Bureau sometime since asking payment for the two 50-pdrs., which had been completed, inspected, tested, and delivered at the Brooklyn Navy Yard, *in compliance with the written instructions from the Ordnance Bureau*, and submitted a written statement, setting forth that I had never before presented the bill from the fact that I had always found it impossible to obtain any satisfaction or adjustment from Capt. Harwood, then Chief of the Ordnance Bureau. I also submitted the following sworn statement, which sets forth the circumstances under which I undertook to make 50-pdr. rifle semi-steel guns for the Navy Department.

(COPY.)

City and County of New York:

M. T. Merritt, of No. 74 Broadway, New York, being duly sworn, deposes and says, that he was present at the Bureau of Ordnance for the Navy Department, in the City of Washington, during several interviews for the negotiation, and read the correspondence between Norman Wiard and Com. Andrew A. Harwood, Chief of the Bureau of Ordnance, in reference to the fabrication by said Wiard, of semi-steel 50-pdr. guns for the use of the Navy, which took place in the summer, of the year 1861, and that deponent was so present as the adviser of the said Wiard, and also at the request of Messrs. Tugnot, Dally & Co., who were interested in the manufacture of guns.

And deponent further says, that said Wiard did then and there represent and state to said Com. Harwood, that he could not profitably undertake less than fifty guns.

That the said Chief of Bureau did consent to give an order for that number, but afterward stated that he wished to reserve the privilege to stop the work upon the completion of any gun, to which Mr. Wiard objected, that not less than five guns could be in course of construction at any one time. And that it was finally decided and agreed both by the Chief and Mr. Wiard, that an order should be given for five, and be renewed for the same number as fast as five were completed.

Deponent further says, that doubt was expressed by Com. Harwood, whether such heavy guns could be properly welded, but no doubt as to the quality of the guns if the welding was successful.

When the subject of the charge was referred to, Com. Harwood said distinctly that *the proof was to be ten service charges fired from each gun, and made no mention of risk on one gun from the fault of another, but on the contrary it was acknowledged by Mr. Wiard, that the failure of a greater or less number of the first five or ten guns might occur*

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during the test, but no apprehension was expressed by either party as to the safety of those that should pass the examination and test, and that after making five or ten, the process would be so perfected as thereafter to insure uniformly good guns. And that Com. Harwood gave frequent assurances that a large number of the guns would be wanted.

Deponent further says, that *no mention whatever was made, that any gun was to be rejected for the failure of another.* And that neither deponent nor Mr. Wiard, as deponent believes, had any intimation whatever to that effect, and that if such had been the case, or if any intimation had been given to that effect, either by Com. Harwood or the Department, deponent would not have advised the undertaking of such fabrication by Mr. Wiard.

Sworn to before me, this 26th day of Jan., 1863.

M. F. MERRITT.

JOSEPH C. LEIR, *Notary Public.*

[L. S.] New York City.

In reply to my application for payment for those guns, in which I mentioned the circumstance related in the foot-note, page 29, I received the following letter from Capt. Dahlgren, Chief of the Ordnance Bureau:

BUREAU OF ORDNANCE,
Navy Department, Washington City, *Jan.* 26, 1863.

MR. NORMAN WIARD, New York:

Sir,—Your communication of the 20th was received on the 24th, in answer to mine of Jan. 19, wherein I apprised your agent, Mr. Stuart, that I saw no reason to reverse the decision of my predecessor in relation to two semi-steel guns for which you claim payment.

As you appear dissatisfied with my conclusion, *I can only offer you the opportunity of an opinion from the Hon. Secretary of the Navy*, and, supposing that course acceptable to you, will make the reference accordingly.

I have no remembrance of the conversation to which you allude; but if Assist. Secretary Watson has said so, it must be so.

It was of course official—therefore supposed to be confidential—and must have been said in the necessary course of business.

When this took place you do not state; but you will perceive that if I did speak of this part of the transaction, which you yourself characterize as an "outrageous *fraud*," I must naturally have considered it in connection with the contracting party, not knowing at the time that there might be others who were responsible for the act.

On receiving your letter I caused the files to be examined, when a letter of Captain Hitchcock was found, in which the following passage occurs:

"I have no cause to think that Mr. Wiard had any knowledge of this transaction," which I presume is what you allude to.

I am, very respectfully, your obedient servant,

JNO. A. DAHLGREN, *Chief of Bureau.*

On the receipt of this letter I made an application to the Secretary of the Navy in reference to my claim, and he told me

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that "*Dahlgren knew all about it, and he would therefore have to refer the matter back to him.*" This occurred on the 14th of February, 1863. Upon this I became satisfied that I had no chance for a proper settlement of my just claims, short of an appeal to Congress, and in some sort to the country. There is justly due me at this moment the sum of $20,000, for the two guns at the Navy Yard, and the two lying in the workshop yet uninspected, from no fault of mine; and by the referring of the whole matter by the Secretary of the Navy to Admiral Dahlgren it will be seen that it is only to the fairness and justice of his irresponsible decision can I look for relief, and that he has once refused.

In justice to myself and others involved with me, I ask that the two guns now lying at the Navy Yard be paid for, and that the inspection of the two guns in the foundery be completed, and, if found satisfactory, that they be also paid for. All of these guns were made upon the *faith of the contract* from the Ordnance Bureau, and it is a *crying injustice that a private citizen should be so deeply involved, through the bad faith and the unjustifiable acts of oppression on the part of government officers.*

The following article from the *New York Tribune*, will give some idea of the necessity for the passage of the foregoing resolution of inquiry, as it sets forth inconsistencies and incompetency that would disgrace any private individual and ruin any private establishment.

ANNUAL REPORT OF THE CHIEF OF THE NAVAL ORDNANCE BUREAU FOR 1862.

Our ordnance officers very properly commence their reports with a *general* confession of ignorance; they occupy page after page with information of what has *not* been done, giving copious details of costly experiments which have failed, and sum up the total results of their experience in a confession of *particular* ignorance. Such is the character of the report of the Navy Department, rendered by Capt. Dahlgren, Chief of the Ordnance Bureau, at the close of last year. It may be divided into two heads, namely: advice to the Department to do certain things, and a labored endeavor to prove that it is almost impossible to do them; and in this respect it is the counterpart of Rodman's work on Ordnance, one of the most important chapters of which is headed "*What We Do Not Know.*" As a knowledge of our own ignorance is the beginning of wisdom, this should have been the first chapter of the work.

Capt. Dahlgren's report sets forth some curious facts. It states that the Monitor was armed with 11-inch guns, and that in its action with the Merrimac "*shot were used with an initial velocity of* 1,120 *feet per second;*"

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but that "*since that time, the same class of gun has been ascertained to be capable of throwing solid shot of* 169 *lbs., with a charge of* 30 *lbs., of powder, giving an initial velocity of* 1,400 *feet per second.*" By this we understand that the capacity of the 11-inch Dahlgren gun has only just been discovered, notwithstanding the vast amount of money, gunpowder, and gun-metal, expended in experiments and trials, but which might have been expended to greater advantage. A similar discovery has been made with regard to the 9-inch Dahlgren gun; but it would seem that we owe these (asserted) discoveries more to accident than to the *intelligent purpose of their designer and patentee.*

Capt. Dahlgren quotes a detailed account of various trials made in England with heavy guns upon iron-plating, showing that guns carrying shot weighing from 156 pounds to 280 pounds, projected by a heavy charge of powder, were capable of penetrating the thickest armor at present considered practicable. From this, he draws the conclusion (about the only one in the report, and that made to his hands by the English press,) that plated ships can not withstand large guns. Then, as if determined to overthrow his second-hand conclusion, he states that, though the Monitor and the Merrimac "sustained for four hours the *utmost efforts* of each others batteries," neither ship was injured! This is a sad overthrow to Capt. D.'s solitary conclusion, and still further strengthens our impression of ignorance, when he, the inventor of the 9 and 11-inch guns, speaks of their "*utmost efforts*" in that action, and acknowledges that he found out, shortly after, that they could be fired with a heavier charge, and thus project the shot with a greater velocity. If he had known this important fact sooner, and if the conclusions drawn from the English experiments are correct, the guns on board the Monitor should have annihilated the Merrimac within half an hour.

Upon reading the English reports, we have arrived at a different conclusion from Capt. Dahlgren's, viz., that the *offense* (ordnance) has the advantage over *defense* (iron-clad ships); for this reason, *that the resistance to the penetration of shot is equal to the square of the thickness of the plate.* That is, if a plate four inches thick will resist a shot moving at the velocity of 1,500 feet per second, a plate eight inches thick will resist a shot of the same weight and diameter, moving at a velocity of 6,000 feet per second; a velocity which can not be attained, while it is very possible that models for ships may be made to accommodate plating of eight inches in thickness. Consequently, as Capt. Dahlgren's famous 9 and 11-inch guns have but recently attained, as their highest velocity, 1,400 feet per second, and that only by doubling the charge beyond what he heretofore considered safe, viz., fifteen pounds, what becomes of his conclusions that ordnance is superior to iron-plating?—or how, in opposition to these facts, can we receive his self-complacent remarks, while eulogizing the power of his *patented* guns, and the immunity they afford against all attacks—"*we have the leisure to consider and devise any other species of ordnance that may be better adapted to the purpose, and are not precipitated into hasty or questionable measures.*" We are compelled to believe that Capt. Dahlgren has been devoted to leisure; as, by his own statement, it has taken

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him several years to find out what charges of powder and weight of shot the guns of his own invention would endure and carry.

To what end, then, we would ask, has Capt. D. devoted years to literally paving the eastern branch of the Potomac with thousands of tons of iron shot and shell in his trials and experiments? What are the results of his experience? Thousands of guns burst; millions of money uselessly expended, and our large guns, up to this time, a failure! The Navy Ordnance officers burst the Army guns; the Army Ordnance officers burst the Navy guns; and the struggle seems to be which shall decry the other the loudest; but out of this struggle comes no trustworthy gun—out of official incapacity comes no light upon the subject. If the Chief of the Ordnance Bureau was ignorant of the (now stated) power of the guns by himself invented, *patented*, tested, of course approved, and now *through his position forces upon the Government*, what have we to expect from the Department? We know the inviolability which surrounds the Bureaux; we know that they are sacred from outside intrusion; that talent, enterprise, and genius would feel strange if they should surreptitiously get in there (the only possible way to do so); but we believe that the exigencies of the country demand that routine, for once, should be set aside, and that light from the outside should be let into the mental darkness which misgoverns and misappropriates the ample means placed at the command of those incapable of using them to the advantage of the country.

The following is from the *New York Tribune* of March 10, 1863:

DAHLGREN ONCE MORE.

The inevitable impression left upon the mind after reading Dahlgren's Report, is, that we are the most inefficiently governed people in the world. That our rulers have been hopelessly blind and besotted, without caution and without foresight. At the commencement of the Rebellion we had but few good guns, and were obliged to "*fall back upon artillery which had been discarded from the service.*" Dahlgren acknowledges that our Navy was not at that time "on a footing commensurate with the obvious wants of the country for *ordinary* purposes." A clear acknowledgment that our Navy, even as a peace establishment, was not up to the proper standard. We had scarcely any niter, an article so important in the manufacture of gunpowder that, as Dahlgren says, "It may be said to be gunpowder itself. Almost our entire supply came through England, and its exportation thence was entirely stopped during the Trent excitement." The scarcity of so important an article must have been known to the Department, and yet, although armed rebellion had been stalking through the land for two years, the Ordnance Bureau has "secured, after resorting to all possible means, a stock of niter, domestic and foreign, sufficient to place our Navy beyond the danger of *immediate* necessities." Cold comfort this, with possible serious complications looming up in the immediate future.

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The efficiency of our Navy, that arm of public service which has been our particular pride and boast, may be judged of from a fact related by Capt. Dahlgren himself, namely, that out of a detachment of *three hundred able-bodied seamen*, placed by him to defend an important point, it was found that *only ten or fifteen of the men had ever served at a gun before!* Dahlgren naturally suggests that "some course of instruction in gunnery may be *instituted* as a part of the system of the Navy." After a century of national existence as one of the foremost maritime powers of the earth, it is suggested, by a high official, that *the handling of guns should be* INSTITUTED *as a part of our Naval system!* Upon what a shallow foundation have we rested the boasted glory, efficiency, and invincibility of our Naval power!

Upon the subject of iron-clads and ordnance, *Admiral* Dahlgren acknowledges the most gratifying ignorance. He does not know whether the armor for ships should be one solid plate or many thinner plates! He does not know how the plates should be fastened to the wood backing! He does not know how to economize the open space of the ports when the gun is out, or to close it when in! He does not know, the number of cannon being reduced to a third of the number he is accustomed to rely upon, how he shall supply the loss of force by the weight and kind of those which remain! He does not know whether he shall use rifle or smooth-bore, breech or muzzle-loaders! He does not know whether it would be better to pierce, or crush and break bolts and strip off the armor, or to attempt to pierce the interior with shells.

This is a formidable account of what our principal ordnance officer does *not* know; and yet, with all these acknowledgments under his own hand, he states, with rare coolness, in a paragraph on a following page, that "*The operations that have been conducted here with reference to the power of different cannon and projectiles, as well as the resistance of iron plating, have been so far satisfactory that the results derived have been consistent.*" Results consistent with what? We look in vain for a single result derived from the experience of Ordnance Officer Dahlgren. We, however, disclaim any emotion of surprise, for we could not reasonably expect a practical result from an officer who, after trying for years guns of his own invention, manufactured under his own supervision, left it to accident to discover that they were capable of bearing double the charge of powder that he considered safe! It should be remembered that to this fatal ignorance may be traced the failure of our arms before Richmond; for had the Monitor destroyed the Merrimac in their first encounter, which she could have done had her guns been charged and shotted to the extent it is now assumed they can bear, the James River would have been free for our gunboats to have coöperated in a victory, instead of arriving just in time to cover a defeat.

We have a reasonable sympathy with ignorance which is unavoidable through adverse circumstances, but we feel justly indignant when a well-salaried officer, educated to his position at the public expense, having at his command unlimited means to solve all doubts by extended and complete experiments, acknowledges in an official document his total want of knowledge on every

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point which one in his position ought to know thoroughly. We feel more indignant still when we know that, while conscious of his own incapacity, he persistently refuses to examine the labors of intelligent minds directed to the elucidation of the very points respecting which he emphatically declares that he knows nothing. Routine abhors Progress, and Routine in the Ordnance Office is the rule to which, unfortunately for our country, there is no single exception. Admiral Dahlgren has invented guns of whose capacities he is entirely unconscious, and has taken out patents for the same in his own name, contrary to all official rule, and with these guns, of unknown qualities, he guards the Ordnance Department from all innovating, *patent-damaging* improvements. Over his official door should be placed, in letters of brass: "*All who enter here leave* PROGRESS *behind!*"

It gives Admiral Dahlgren "pleasure to bear testimony to the promptness with which the private founderies have met the demands on them from the Government." This is a generous acknowledgment of merit, but we receive it with much suspicion. The demands are met undoubtedly; but how? What is the per centage of failures? What is the cost to the Government for the countless experiments to arrive at these failures? The experience of Captain Rodman, Chief of the Army Ordnance Bureau, is totally adverse to the spirit of the above compliment to "private founderies." He says, after frankly enumerating a fearful list of failures, that

"These facts, to my mind, are conclusive as to the fact that we are at present far from possessing a practical knowledge of the properties of cast-iron in its application to gun-foundering; and it is too much to expect of private enterprise to take up and prosecute so intricate and expensive an inquiry."

He further suggests that a series of experiments should be entered upon, at the expense of the Government, *as early as practicable!* For what are the millions of public money expended upon our Ordnance Departments, if not for the purpose of arriving by experiment at the very knowledge which our chiefs confess they do not possess? The Secretary of the Navy did not sustain Dahlgren's compliment to "private enterprise," when he applied to Congress for $30,000,000 to establish vast Government founderies to perform what Dahlgren asserts is so well performed by *seven* private firms. We are loth to attribute motives to others which are only remotely discernible, but we are forced to inquire if there can be any mental connection between the "compliment" and the concluding paragraphs of Dahlgren's report, which are as follows:

"In conclusion, I beg to ask your consideration of the present organization of this Bureau. The nature of its duties are military as well as civil, and the minutest details of a cannon or its management on shipboard are subjects of its cognizance, as well as the directions for making cannon and all their complicated appliances.

"It is thus necessarily in the closest professional contact with commanders of fleets and of ships, as well as of founders and mechanics."

If further powers were confirmed to this Bureau, the "seven private firms" could hardly fail to find a friend in the officer who so handsomely complimented them.

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Resolved, That the Secretary of War be, and he is hereby, requested to report and inform the Senate, what improvements, if any, have been made or proposed and adopted by regular ordnance officers under the auspices of his department since the rebellion commenced, or since the adoption of large rifled guns; in materials for, or methods of construction of, heavy ordnance, rifled or smooth-bore.

What failures have occurred during experiments upon heavy ordnance, and what failures of the same in services, whether of guns furnished under contracts with his department, or obtained from the Navy Department.

What was the weight of powder and shot, the calibre, material and weight of heavy guns that have failed.*

What was the rate in time of firing, what the state of the atmosphere by the thermometer, and what the condition of the weather, fair or rainy, at the time of firing of each gun, so far as observations were taken and reported to his department.†

What number of rifled field guns have been mounted on the standard 6-pdr. field carriage, and what changes have been made, if any, to adapt the 6-pdr. carriage to rifled guns.

How many of the 6-pdr. field carriages, on which have been placed rifled field guns, have been disabled or injured by breaking or bending of their axles; and how many 12-pdr. field carriages, on which rifled guns were mounted, have been disabled or injured in the same manner in service, or during experiments conducted in presence of ordnance officers.

What number of 10-pdr. Parrott rifled guns have been placed on 6-pdr. carriages, and what number of 20-pdr. Parrott guns have been placed on 12-pdr. carriages, and what elevation can be attained with Parrott 10 and 20-pdrs. when mounted on such carriages.

What is the recoil, when fired with service charges of the 3-inch wrought-iron gun, and 10-pdr. Parrott gun on 6-pdr. carriages, and how much the recoil of the 20-pdr. Parrott gun when mounted on the 12-pdr. carriages?

What rifle projectiles have been used in service in these guns, and at whose requisition or recommendation in every case, with the name of the designers or manufacturers, and with what results in each and all cases?‡

How many rifled guns of the above named sizes have been left on the field of battle, or captured by the enemy, from the disabling of the carriages; and what number of rifled guns have been recovered from battle fields, after having been buried, to hide them from the enemy, in consequence of the breaking down of their carriages from causes other than hostile shots?§

What number of rifled or smooth-bore muskets have been purchased from foreign countries since the war commenced?‖

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* See Wiard's Pamphlet "Great Guns," pp. 14 to 19 inclusive.
† " " " " " 44 to 66 "
‡ " "Projectiles," p. 50.
§ " Wiard's Pamphlet "Field Artillery," pp. 20, 21, 22.
‖ " " " "Small Arms."

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And how many of them would interchange with the Springfield rifled musket ?*

How many would interchange with each other in all their parts, and how many of them would interchange with the Springfield musket parts, bayonet, stock, lock and barrel only; and how many would interchange with each other for that number of parts, viz., bayonet, stock, lock and barrel ?

How many Springfield muskets have been repaired on the field from parts of other damaged Springfield muskets, and how many Springfield muskets have been returned to the arsenals to receive lost or damaged parts ?

Has it been the practice of the inspectors to receive what are called English Enfields, or guns similar in appearance, without the test of firing barrels with powder, and were they so received because of the careful and reliable inspection and stamping of all English made barrels, at official proving-houses established by the British government, at which all English made barrels are proved ?

And what exertion has been made by the Ordnance Department to have such a system adopted by the United States Government to facilitate the production of guns of home manufacture ?

What number of rifle muskets, Springfield pattern, have been ordered, and how many received from private contractors of the manufacture of the United States ?

And how many of United States manufacture have been ordered to be made of uniform appearance with the Enfield rifle, and to interchange to the extent of lock, stock, barrel, and bayonet ?

How many have been offered (if contracts could be made,) of this last class of gun ?

How many have been contracted for, and how many delivered, and at what prices, and what is the highest price paid for Enfield rifles (so called), exchange and transportation added ?

And how many have been purchased at that price ?

How many have been purchased of which the whole cost, with transportation, exchange, and commission, amounted to more than $14, how many above $16, how many more than $18, and how many over $20 ?

ON U. S. STANDARD GUN CARRIAGES.

(*From the N. Y. Daily Times, Oct.* 30, 1861.)

Over 1,200 new standard carriages have been ordered by Gen. Ripley, a majority of which are stated to be designed for the Parrott guns of different calibres. These carriages are made so as to allow but fourteen degrees of elevation to the standard bronze guns, which are much shorter, lighter and smaller in diameter at the breech than the Parrott guns. The effect of this has been found to be as follows: Not more than eight degrees of elevation can be obtained on the 10-pdr. guns, and not more than from six to eight on the larger guns ; it also necessitates a change in the location of the elevating screw on the trail,

* See Wiard's Pamphlet "Small Arms."

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while the weight of the gun is very much greater than that of any other field guns of similar calibre and weight of projectile.

With rifled guns and suitable projectiles there is no difficulty in working the extreme theoretic elevation of the gun, thus placing shot and shell with accuracy and effect to the extremest ranges, if the carriage be properly constructed to allow of the requisite degree of mobility and elevation. Thirty-six degrees is the theoretical maximum of elevation fixed for cannon, while the standard mechanical adjustment on all United States field carriages is under 15 degrees, much less than is required for rifled guns properly worked. The tenacity with which army ordnance officers adhere to standard forms is illustrated by the fact, that of the 800 carriages designed for rifled guns of entirely different sizes and forms, all have been constructed on the old unchanged models, specially designed for smooth-bore guns of uniform standards. Another fact has been developed in this direction which is still more singular. Two United States Army Inspectors, for instance, will order carriages; one will direct the constructor to imitate a standard carriage in all its measurements and details exactly to the 200th part of an inch. The other will direct that the constructor shall exactly follow the standard drawings prepared by the Ordnance Department, without the least deviation. Now, upon making a careful examination of some of the standard 6-pdr. carriages, which the standard drawings make exactly 9 6-10 inches between the cheek-pieces or trunnion bearings, the constructor finds that the cheek-pieces are 10 inches apart, together with many other differences. On examining the standard drawings, the constructor will find errors even there, and that, as in the case of the arrangement of the spare pole and the spare wheel drawings for the standard 6-pdr. caisson, it will be impossible to follow the standard drawings.

These are facts—and are they not disgraceful facts? And do they not properly lead to the inquiry whether there is not a vast deal of pretensious ignorance hid beneath official uniforms and reticence?

THE BANKS EXPEDITION.

136 East Thirty-third Street, New York,
March 7, 1863.

Peter H. Watson, Esq., *Assist. Sec. of War.*

Sir,—On the 12th day of December last, I procured a discount for $18,000, which enabled me to pay cash for part of the stores I had furnished the Government for the Banks Expedition, and at that time I paid $223 51 interest for the loan at sixty days. Nearly all the supplies I furnished, were from drawings carefully prepared originally by myself, at considerable cost of time and money. These drawings, copies of which I furnished to the War Department, and for which I received no remuneration, were exhibited to Gen. Banks, who approved of them, and ordered the supplies to be got ready, with the condition that they should be completed within two weeks. Twelve

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launches had to be made, but on applying to boat-builders, I was assured that it would take six week, at least, to build one launch. But as the order from Gen. Banks was imperative in regard to time, I refused to listen to such conditions, and did succeed by great personal exertion, in having these launches ready in season for the expedition. To achieve this, I had to pay cash down, or in advance, for the best mechanics in this City have no faith in the prompt payment of the Ordnance Department. For myself, I had confidence that Gen. Banks would see me promptly paid, although I had no conversation with him on the subject from want of time, as, in addition to my severe duties of putting stores on board, I had magazines to build on the transports, and articles to manufacture, in almost every branch of mechanical business, and all to be completed in a limited time.

While I was attending personally to putting stores on the steamer North Star, on December 6, I was informed that Gen. Banks would leave on that day. I at once called upon him at head-quarters, to say that my accounts would require to be audited by him before he left. He said if I would be on board the steamer as she moved down the bay he would come on board off the Battery with a tug, which he would detain for my return, and that as we went down he would audit or attend to the accounts. I prepared a copy of my accounts, and remained on board the steamer when she left the dock. Gen. Banks did not come on board, but the small steamer conveying him and some of his friends moved alongside the North Star as we sailed down the bay. When the General did come on board, I met him at the gangway, and reminded him again of my accounts. He directed the small steamer to wait for me, and examined my accounts, with the assistance of Col. Holabird, and wrote

Approved,

N. P. Banks, M. G. C.

I forwarded the accounts, approved by the General, to the Ordnance Department, accompanied by a copy of a letter from him to me, speaking approvingly of my manner of performing my duties, and of my services. These accounts Gen. Ripley refused to pay, and they were returned, for the alleged reason that no receipt of a U. S. officer accompanied the account. This is a mere quibble, as Gen. Ripley should know that Gen. Banks would not approve these bills unless the stores were delivered. He also knows that I have always sacrificed myself for the interest of the Government; and he does know that I was directed by the War Department to take a position under Gen. Banks, in which I must obey his orders. The result is, that I have had to renew my note of $18,500, and again pay $219.97 interest. I have large means and credit involved for the Government, and, after nearly two years' faithful exertion to do it good service, I am left to bear the most oppressive difficulties, without either aid or sympathy; and I am paying interest for a large amount of money on Government account, for which no

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allowance will be made to me at any time, even if I should eventually be paid the principal. In a few days my second note will fall due, and I write to ask that you will see that my just claims are settled, and that I am relieved from the oppression arising from the obstacles thrown unnecessarily in the way of my payment by Gen. James W. Ripley.

Respectfully,

NORMAN WIARD.

LETTER OF GENERAL BANKS.

NEW YORK, December 4, 1862.

My Dear Sir,—I desire, at the moment of my departure, to make to you my unqualified acknowledgments for the valuable assistance you have rendered me in fitting out my expedition. Your suggestions have been most important and your services valuable. When I can, you may rely upon my fully reciprocating your favors. As soon as time will permit me I will make known to the Secretary of War my opinion of your efforts. I remain, most truly and sincerely, Your friend, etc.,

N. P. BANKS.

NORMAN WIARD, Esq.

CONTRACTS WITH THE WAR ORDNANCE DEPARTMENT.

The contract system at the War Ordnance Department under General Ripley, is exemplified in the following statement of facts. It would probably be characterized by all honorable men as an instance of gross corruption and favoritism. It, at all events, offers a good and sufficient reason why no honest man can hope for a fair competition in any business with the Department, although the proposals are publicly advertised for competition.

In the month of May, 1862, an advertisement from the Secretary of War, appeared in many papers, for 5,000 tons of lead. In the month of June, the order was modified to 1,666 tons, sealed proposals to be opened on the 5th day of August. Early in July, the firm of Naylor & Co., New York, addressed a letter to the Ordnance Department, offering to contract for lead, and were assured by the Ordnance Department, through Gen. Ripley, that no open proposals could be received, but inviting sealed proposals, to be opened 5th August. About

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the 19th July, one of the firm of Naylor & Co., Mr. Huntington, appeared at the Ordnance Department, and remained there several days, until the 25th of July, on which day he made an offer to the War Department for 3,590 tons of lead. It was referred the same day, to Gen. Ripley for report. On the same day a contract was recommended; on the same day a contract was approved, which contract stipulated, that 897 tons were in store, and 2,693 tons were at sea, and to arrive. At that period there was in store belonging to the Government, 2,800 tons, equal to 50 to 55 day's supply. On the 5th day of August, the farce of opening the sealed proposals was supposed to have taken place. The commission on Ordnance and Ordnance stores, in the elaborate decision of the Mason case, No. 71, decided that all contracts for prospective deliverly, should be by public advertisement only, and to be given to the lowest bidder. By this decision, every contract approved by the Hon. Simon Cameron, Secretary of War was declared null and void.

The present case of Naylor & Co., as passed by the Ordnance Department, under Gen. Ripley, *was a deliberate act of malfeasance of office:* 1st. In violating the Act of Congress of March, 1809. 2d. In violating the honor pledged to those who sent in sealed proposals. 3d. A gross favoritism to this firm of Naylor & Co. The act of Gen. Ripley actually nullifies the action of the commission on ordnance and ordnance stores in every case, and deters honorable merchants and manufacturers from presenting sealed proposals, from fear of such violations of public faith. Naylor & Co's. contract was purely prospective, as 2,693 tons were to arrive. The original advertisement for 5,000 tons having been reduced to 1,666 tons, together with the fact that 2,800 was in store belonging to the Government, shows that an exigency did not require such a contract.

I have been informed that Huntington was an old Springfield friend of Gen. Ripley.

When a lot of tenders for small arms were opened, Captain Balsh broke the seals, Captain Benton read the contents, while a clerk recorded. A similar ceremony took place at the time of opening sealed proposals for infantry goods.

But when the proposals for lead was recorded, they were

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brought to the clerk on the 6th of August instead of the 5th, the seals already broken! Query.—*Were they opened on the 5th of August or on the 25th of July?*

For a corroboration of these facts, examine the National Intelligencer, Washington, for advertisment for sealed proposals for Lead, May and June, 1862. Also—

Call for the letters of Naylor & Co., early in July, with the replies thereto.

Call for the contract passed on the 25th of July, 1862.

Ask what number of sealed proposals were received and opened on the 5th day of August.

Ask for the supply of lead on hand on the 25th of July, and what is the rate of consumption.

Another gross deception practiced by the Army Ordnance Bureau under Gen. Ripley, with a view to blind the public to a sense of the utter exclusiveness of that office, may be found in the system of advertising for Proposals for cannon, after the following manner:

ARMY AND NAVY PROPOSALS FOR CANNON.

Proposals will be received by the War and Navy Departments until the 23d day of June, 1862, for the fabrication of the following heavy cannon, viz:

1. XV inch smooth bore—not to exceed 50,000 pounds in weight.

2. XII inch rifle—to be of the same exterior form and proportional weights as the XV inch smooth bore gun. The length of the guns over all, are not to vary essentially from standard guns of same calibre, viz., about 16 feet.

3. The ship guns to be constructed with a preponderance one-sixteenth of the weight of the piece, and to have a cascable for an elevating screw.

4. The fortress guns to have ratchets for elevating, but to be without preponderance, as is the case of the new pattern Columbiads.

5. The first gun of each kind to stand a proof of one thousand rounds with a charge of powder of *one-fourth* the weight of the shot for the XV inch, and *one-fifth* for the XII inch. The shot for the XV inch gun to be not less than 450 pounds in weight, and to have an initial velocity not less than 1,500 feet; and for the XII inch rifle not less than 500 pounds, with an initial velocity not less than 1,300 feet.

Should the trial guns pass the prescribed proof and inspection, each branch of the service will contract for twenty of each kind, to be made precisely like the trial gun in every respect; provided, that each gun stands a proof of one hundred rounds with service charges.

7. Should the trial guns stand the required proof, the Government will pay

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the expenses attending the proof, and for the guns. Should they fail to do so, the costs, with the exception of the powder, will fall on the contractor.

8. The price of each gun is to be stated, and the proposals are to be accompanied by sketches showing the form, dimensions, and calculated weight of the guns, and likewise the material proposed to be used in their construction.

9. The time of completion for inspection of the trial guns is not to exceed ninety days, and the limit for the completion of the remainder to be within nine months.

10. The Government reserves the right to reject any or all the proposals if not satisfactory.

11. Proposals should be addressed to the "Navy Department," and be indorsed "Proposals for Heavy Guns."

EDWIN M. STANTON,
Secretary of War.

GIDEON WELLES,
Secretary of the Navy.

We will pass over paragraphs from 1 to 4. The fifth paragraph exhibits the cloven-hoof, as follows: The 15-inch gun is to carry a shot not less than 450 lbs. in weight, and is to stand 1,000 rounds with a charge one-fourth the weight of the shot, or 112 and a half pounds of powder. The 12-inch rifle gun, is to carry a shot weighing 500 lbs. and to stand 1,000 rounds with a charge one-fifth the weight of the shot, or 100 lbs., the initial velocity being respectively 1,500 and 1,300 feet! The Ordnance Department and Bureau knew, when that advertisement was put forth, that no gun ever made in this country or elsewhere, could stand the proof required. When it is remembered that the great 11-inch Dahlgren gun, *was only capable of sustaining a charge of* 15 *lbs. of powder*, although it has *recently been discovered*, so the inventor Dahlgren says, that it can now *stand a charge of* "30 *lbs. of powder*" *for a few rounds*, it will be understood that the Department could not expect to receive an outside proposal; they require outside contractors to furnish guns which will respectively endure 1,000 rounds of 112½ and 100 lbs. of powder, (*the regular service charge of the* 15*-inch guns being only* 40 *lbs. of slow burning powder*) and if they fail under this outrageous test, all the expenses, except the powder, are to fall upon the contractor. Advertisements asking for tenders for ordnance are, therefore, bare-faced shams or worse, and the only party deceived by them is the public.

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The people are possibly not aware of the cost of these gun trials. Supposing a 15-inch gun had been offered which would stand the test of 1,000 rounds of 112½ lbs. of powder, the weight of powder expended would have been 112,500, or over *fifty-six tons of gunpowder*, which, at say 25 cents per pound, would cost the Government some *twenty-eight thousand dollars*, for testing one gun which might burst at the one thousandth round. Ordnance Bureaux, as generally conducted, are expensive and, unfortunately, very useless luxuries.

THE SICKLES CONTRACT.

I made a contract with General Sickles in May, 1861, for three batteries of Field Artillery. In August following, I paid $12,600 in cash for the carriages. On the 3d of October, 1861, the contract was assumed by the War Department, and the batteries were delivered in forty days from that date. Two of these batteries were not paid for (their price for the two was $23,000) until the early part of 1863. See "Field Artillery" Pamphlet, page 6.

I prepared these batteries under the impression that they were to be inspected and delivered in New York. Having completed the first battery within the time specified in the contract, as I did the other two, I notified Gen. Ripley in writing and by telegraph of the fact, *not knowing then that he had previously made a report to the War Department, setting forth that these batteries were not needed, notwithstanding he had never seen a battery of mine at the time of making the report.* He paid no attention to my notifications, and I applied directly to the War Department, and the batteries were ordered to be delivered to Quartermaster Tompkins, to be forwarded immediately to Washington. Nothing was said about inspection in the order from the War Department, and I had never been able to obtain a copy of the printed instructions for inspection; and in fact, at that time, there was no fixed standard for inspection and testing of rifle guns

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established by the Ordnance Department. Neither could I obtain any oral instructions about inspection from Gen. Ripley.

My contract stated, that each gun was to be fired with ten service charges. The first two batteries were submitted to the following outrageous treatment by the inspector, Col. Kingsbury. Each gun was subjected to five triple charges of musket powder, fired on the carriages; then to five charges, one half less, under the same conditions. The first battery sustained this treatment without showing the slightest defect in guns or carriages, much to the surprise of Col. Ramsay, Superintendent of the Washington Arsenal, to whom I am under many obligation for official and gentlemanly courtesies, as I am also to Capt. Benton and some other Ordnance Officers The second battery was found to pass this tremendous ordeal with similar results, with the exception that two of the 6-pdrs., were found to have some slight defects in the centre of the breech, and were withdrawn; one without firing at all. These defects consisted of a pin hole in one gun, about two inches deep, which after repeated firing since has shown no sign of further injury. The other gun had a defective weld through which a small amount of gas exuded, in being fired with a triple charge. The two defective guns were left for one month in the arsenal to be examined by Ordnance Officers, and by an agreement with Col. Kingsbury, two other guns were sent on to supply their place. The third and last battery was completed and delivered to the Quarter-master, and forwarded to Washington, when the two new guns of the second battery, together with the third battery were inspected and fired, *with service charges only*, for I had been informed by Colonel Ramsay of the *outrageous test to which the other batteries had been unjustly subjected, in violation of the conditions of my contract.* One of the 12-pdrs. of the third battery was found defective at the first fire and withdrawn, *it being one which I had condemned at the foundery, and had been sent by mistake of the man who prepared the battery for shipment, as I was afterward informed,* I being at the time employed in the most strenuous efforts to fit out the ordnance and stores of the Burnside expedition, also in inspecting small arms for the government, during the illness of the

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able and honorable ordnance officer stationed at New York, Major P.V. Hagner. An an arrangement was entered into with Col. Kingsbury that another gun should be supplied within six days, which was done, when the inspection was to be completed and certified to. The defective gun was, by accident, left loaded, and about an hour after the inspection was closed, my friend and representative, Mr. H. L. Stuart, on examining it, with a view to dismounting it to send it back to New York, with the two defective 6-pdrs. of the second battery, ascertained this fact, and thoughtlessly discharged the gun, *bursting it, and disclosing a very defective weld in the gun, which I had myself noticed, and which caused me to condemn it at the foundery.* Mr. Stuart was seriously injured by the shock, and came very near being torn to pieces, as he stood within four feet of the gun at the time of the discharge. This circumstance was made a reason by Gen. Ripley for refusing to take any further action in regard to the batteries,* he not even answering several of the communications I made to him, and not until the commencement of the present year could I obtain a conclusion of the inspection and final settlement of my claim; and this was only obtained through the persistent efforts of the Honorable P. H. Watson, Assistant Secretary of War, to whom I am under many obligations for his exertions in this matter. Two thousand dollars were deducted from the price of the two last batteries, the first having been paid for, on the certificate of Col. Kingsbury.

The depreciation in the value of currency, added to more than $1,000 expended for lost supplies and in keeping the batteries in order, the cost of repeated journeys to Washington, with the loss of the use of the money, resulted in a direct loss to me of not less than eight thousand dollars, while the injury to my credit as a gun founder, from causes *over which I had no control, and for which I was in no way responsible,* was indirectly of much more serious consequence.

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* The above-mentioned small guns are all the small guns of my fabrication that have ever failed at inspection at the foundery or in service, as Gen. Ripley has been repeatedly informed, verbally and in written communications, and a large number of them are in service, as will be seen by referring to pamphlets Field and Marine Artillery.

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The guns of these batteries were pronounced, by the ordnance officers and artillerists who proved them at the arsenal, to be superior to any rifle guns that had ever been tested there, for range, accuracy, mobility, and ease of management. The carriages were of my peculiar construction, as illustrated in my pamphlet on "Field Artillery," no one of which has ever been known to break its axle, or to fail in any part for want of proportion or strength to sustain the action of its gun. The Sickles' or Excelsior Batteries were of the same kind as two of the field batteries furnished by me to Gen. Burnside, and the four furnished by me to the State of Ohio, on the order of the War Department, and which have been in service on many a battle-field, from Shiloh to the last battle of Bull Run, and which have, in numerous trials with all the various field guns in the United States service, demonstrated their superiority and power over all others of similar calibre.

Gen. Sickles was authorized by the War Department to raise three companies of artillery to work these guns, which were designed to be attached to and form a part of his "Excelsior Brigade." One of these companies was raised after almost infinite difficulties, taken to Washington, where it remained several months, being unable to get its battery or its horses.

Gen. Ripley refused to act, and Gen. W. F. Barry, then Chief of Artillery and now Inspector of Artillery of the Army of the Potomac, declared to Gen. Sickles, as that able officer informed me, that "*these guns should never go into the army of the Potomac,*" and, finally, the first company, in despite of Gen. Sickles, was broken up and distributed among other artillery companies. The second company was raised, passed through similar experience in Washington, and finally was compelled to take a battery of bronze smooth-bore guns, through the direct action of Gen. Ripley. The third company, after much difficulty, was finally given up, the obstacles thrown in the way of its formation by Gen. Ripley and Gen. Barry were found to be insurmountable. *These batteries still stand in the Washington Arsenal, with two others of the Ohio batteries, taken away from Gen. Sigel's corps, where they may be seen and examined, and where they are likely*

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to remain if Gen. Ripley can keep them there, which he certainly will do if he can succeed in keeping himself in his present position.

See letters of commendation from Gen. Sigel and other officers in my pamphlet entitled "Field Artillery."

By referring to the file of papers connected with the two last batteries made for the Excelsior Brigade, it will be seen that the Secretary of War, several times, ordered the settlement of my account, and Gen. Ripley as often referred it back for further consideration; and at the time an extreme proof of one of my guns belonging to these batteries was ordered, in which it was to be fired five hundred rounds, at a cost to the Government of more than one thousand dollars, there was in the Arsenal six guns of the 12th Ohio battery, each of which had been fired more than that number of rounds in service, which fact I communicated to Gen. Ripley, but it did not have the effect to deter him from this waste of public money.

THE FREMONT CONTRACT.

I had a contract made in August by telegraph, with Gen. Fremont, for two batteries, one of 12-pdr. Rifled Field Guns and one precisely like the Sickles' Batteries, with two 12-pdr. and four 6-pdr. rifles. At the request of Gen. Fremont, I sent two guns to St. Louis, at the cost of several hundred dollars, with a special representative to have confirmed in a proper manner the contract made directly with him, and to receive his full instructions as I found it *undesirable to deal with the agent* who first opened the subject to me for Gen. Fremont. This contract was subsequently interfered with by Gen. Ripley, and annulled in spite of the earnestly expressed wish of Gen. Fremont to have the batteries. The contract was made with Capt. Callender, Chief of Ordnance to the Army of the West and Supt. of the St. Louis Arsenal, on the direct order of Gen. Fremont, who remarked, "that the guns would be invaluable to him then on the eve of his brief active campaign," (September 26, 1861.)

A copy of the contract was forwarded by Capt. Callender to

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Gen. Ripley, who at once induced the War Department to interfere with its execution. Soon after I sent all of my original telegraphic despatches and papers received from Gen. Fremont and my replies thereto, to Asst. Sec. Scott, and he had them registered as received by him on the 14th of Oct. 1861, in the Record Department, of the War Office, where the record can be seen. I informed him they were only submitted for inspection and to be again returned to me. He sent them to Gen. Ripley. These papers were mine and only sent for examination to confirm the facts in the case, as Gen. Ripley had at the time a copy of the contract from Capt. Callender. They were my only means of showing the terms of my contract and all the conditions thereof, with the personal directions of Gen. Fremont, which led me to incur the expense and trouble of sending two guns to St. Louis, with a special representative. The price of these batteries was to be the same as that of the Sickles, Burnside and Ohio Batteries. I have since repeatedly made demands for the return of these original papers of mine, and as a result have been told by Gen. Ripley, that they *could not be obtained*, except on a call of Congress or an order of the Secretary of War. Being somewhat surprised at this, I made some inquiries into the character of Gen. Ripley's method of doing the business of his office, and have since, in consequence of results obtained and on the advice of others who had a similar experience to mine, have concluded not to place any more original papers relating to business affairs in the hand of Gen. Ripley, without first taking certified copies of the same. My loss in this transaction was considerable, a statement of which prepared as full as possible, without the original papers, has been forwarded to the Secretary of War. The only original paper I have connected with this transaction, being the following letter:

St Louis Arsenal,
Nov. 21, 1861.

Mr. Norman Wiard, 136 East 33d St. New York.

Sir,—I received, last evening, a letter from the Ordnance Office, of which the following is an extract:

"*Sir*,—I have to acknowledge the receipt of your letter of the 10th inst. and to state in reply that this Department can not, under the law, recognize the contracts which you have made by the orders of Gen. Fremont."

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I am not aware whether you have taken any measures to carry out the order which I gave you on the 23d of September last (1861), by order of Gen. Fremont, but if you have, I give you the information I have received, at the earliest moment in my power, so as to give you the opportunity, should you think proper to do so, to present your claims before the Commissioner now in session in this city.

Respectfully your obedient servant,

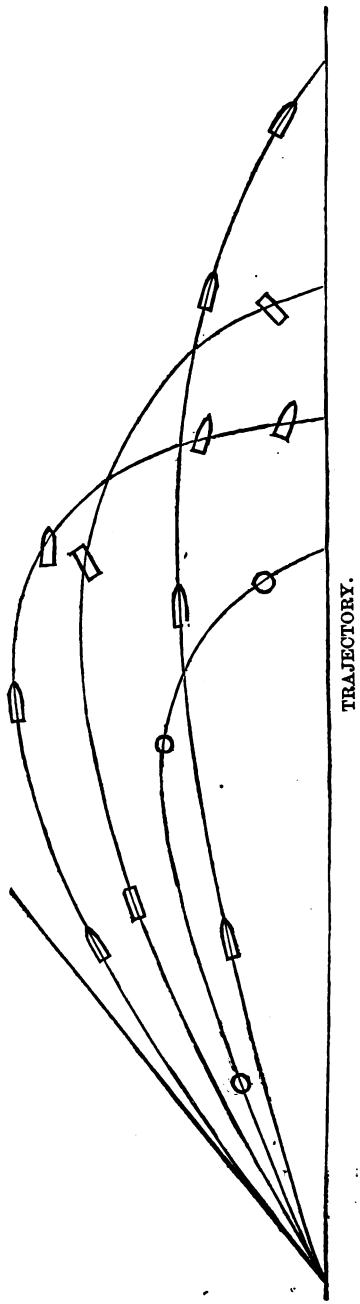
F. D. CALLENDER,

Capt. of Ordnance.

PROJECTILES.

The following remarks upon the subject of rifled projectiles, which have been used in service, will give a clue to the proper method of investigation, suggested by that part of the Resolutions of Inquiry relating to projectiles for rifled field guns.

The diagram represents the trajectory or line of flight, and the position taken and maintained by correctly and incorrectly designed projectiles when delivered from rifle guns. Also the position of a round shot when fired from a smooth-bore gun. The highest line represents the trajectory of a shell fired at an elevation of 35° from my rifle gun, when used for extreme ranges to disturb an enemy, or when it is



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used as a mortar to drop shells into an enemy's town, fort, or camp, with small charges of powder. By an examination of this diagram it will be readily perceived how absolutely necessary it is, if efficiency and explosion are to be invariably secured from rifle projectiles, that they should be so designed, constructed, balanced, and adjusted as to insure their certain flight, turning on their axes on the line of their trajectory in the position they leave the gun, so as to strike the object aimed at head on. From this can be judged the incapacity of the Head of the Army Ordnance Department, practically equivalent to active treason, which could let hundreds of thousands of projectiles go forward to our loyal citizen armies battling for the Union and our national life, to almost certainly betray them to disasters, if not annihilation. The so-called Parrott projectiles are designed upon principles that make it impossible for half of them to fully take rifling, and not one in ten ever passes steadily along its line of flight, turning on its axis.

These projectiles were invented by Dr. John W. Reed of Montgomery, Ala., a rank Secessionist, and now in the Confederate army, who has furnished to the South a large number of them, improved by a ring on the forward part to make them turn on their centre. Several hundreds of these shells were captured at Shipping Point, and now lie among the trophies collected by Admiral Dahlgren at the Washington Navy Yard. Dr. Reed was engaged here, at West Point and Old Point Comfort, for nearly two years under Floyd's administration of the War Department, in experiments upon his shell. He disposed of a portion of his invention to Capt. Parrott, and offered another portion to a gentleman now in this City, with a view of getting it introduced into service, his idea being to furnish it as the projectile for the old cast-iron guns, for the rifling of which the late Gen. James had a contract from Floyd. The Parrott guns are specially designed to use this projectile, and more than one written protest from Parrott against the use of any other, and especially the Hotchkiss, have been made to the Army and Navy Departments, which have received respectful attention, and to a very great extent have been regarded as authoritative. The 10-pdr. Parrott has a calibre of $2\frac{9}{10}$ inches,

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or one-tenth less than than the three-inch rifle gun designed by the Ordnance Department. The Parrott 20-pdr. gun has a calibre of $3\frac{67}{100}$, instead of the $3\frac{80}{100}$ rifle bronze gun designed to use the James projectile; and his 30-pdr. differs a tenth or two from any other 30-pdr calibre; a variation admirably designed to secure the exclusive use of the Secessionist Reed's invention, bearing the name of Parrott, who was himself a graduate of West Point.

The "Dyer" projectile, so-called, was simply a mechanical absurdity, utterly worthless. The Schenkle projectile, when new and perfectly made, has some good qualities when fired from guns properly rifled; but their defects are such as to compel even the Ordnance Department to refuse to order more of them. All of these shells are known to have failed in their flight, and to have killed our own officers and men, and all of them are liable to do so, when fired over the heads of troops in advance under the cover of batteries.

SMALL ARMS.

(*Extract from Wiard's Pamplet entitled "Small Arms."*)

My sympathies have always been with the producer. I have always believed that we could carry on a formidable war, even without exhaustion, if our Government would take care that it was so conducted that our surplus of life, labor, mineral and agricultural products alone were expended. In this view, to some extent, the blockade has been of advantage to our enemies. They have been *obliged to learn* this important part of the art of war, and their present confidence comes principally from the discovery that they can, by wearing homespun and eating corn, never be further exhausted. Had there been no blockade, we should have had two chances to have captured their cotton, viz.: when on shipboard leaving ports, and when its price, whether in gold or manufactures, was returning to them; and they, whenever they found their King Cotton cap-

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tured, and themselves without the skill to produce corn instead, or to manufacture French boots or English broadcloth from cotton, would have felt themselves conquered.

Holding these views, it will be believed that I have watched with great anxiety the purchase of worthless small arms from Europe, of which it was said by the Commissioners on the Purchase of Arms, Messrs. Holt and Owen, in their report of July 1, 1862, page 3: " * * the practical result has been that a large proportion of our troops were armed with guns of a very inferior quality; *that tens of thousands of the refuse arms of Europe are at this moment in our arsenals*, AND THOUSANDS MORE TO ARRIVE, NOT ONE OF WHICH WILL OUTLAST A SINGLE CAMPAIGN; *while most of them will not be issued at all*, BEING ENTIRELY UNFIT TO BE PLACED IN THE HANDS OF CIVILIZED TROOPS."

This resulted in a national calamity, for we not only did not get the quality of arms we required, but the Government was by this means driven to Wall Street, to purchase gold to pay for the inferior kinds we did get, and the result (due principally to this cause) has been to enrich speculators and brokers, and to so far discredit the National currency, that double prices have (nominally) to be paid by the Government for all the expenses of the War. The late Secretary of War, Mr. Cameron, and his assistant, Mr. Scott, seem to have had some "faint idea" of the importance of manufacturing arms at home; for in their letters and orders to Gen. Ripley, as published in the report to Congress on that subject, that policy is several times favorably mentioned; and when it is recollected that one of our national boasts is that our mechanics are unequaled for ingenuity, skill, or enterprise by any others in the world, it becomes a proper subject of inquiry to learn how a policy so dangerous and disastrous could have had so much influence; why that policy, so beneficial to our artisans, and so advantageous to our country, both as to outlay and efficiency, has been so entirely ignored by the Ordnance Department, under Gen. Ripley. I explain it in this manner: Our regular army officers are educated, at the public expense, to look upon soldiers as mere machines; and, as all their associations are con-

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nected with discipline and command, they finally begin to look upon all mankind as soldiers, and upon themselves as "born to command!" As they are officers for life, and as their physical wants are supplied by the Government, their ambition incites them only to look for power and advancement. As their first step on entering the school was taken by political influence, they look earnestly for the way by that means to perpetuate that influence, and to use it to their own ends. If a large appropriation is to be expended for Government work-shops, *they* are the men who seek to manage it, so that cadets may take their places. When arms are to be manufactured or inspected, who should do it so well as the officer who has been regularly educated for such duties? And to this state of things no one objected in time of peace, and no one at that time contemplated the formidable war we are now involved in.

The Springfield rifled musket, manufactured at a well-appointed establishment in time of peace, and with all the elegant leisure which peace insures, was certainly a superior arm, and the fallacy of "interchange" of all its parts a nice mental and physical exercise for theorists. Its construction, with that nicely-involved and expensive machinery, required continued vigilance, and in time of peace afforded places and exercise for a number of gentlemanly officers. These the Springfield musket and armory supplied. But I am sorry to say that it supplied but little more, for, at the beginning of the war, when the Government supposed that 75,000 men was a sufficient army, Gen. Ripley recommended the purchase of 100,000 foreign muskets and eight batteries of cannon, through the agency of a General visiting England, an evidence that, notwithstanding all the preparations so long employing the *master military minds*, we were *unprepared*.

Gen. Ripley, at this time, knew very well that a new manufactory could not be prepared for the manufacture of SPRINGFIELD muskets, with the necessary machinery to produce 1000 muskets a month, with less than $200,000 capital AND ONE YEAR OF TIME. He also knew that if any arms were purchased abroad, they would not exchange in a single part, not even the cone, either with themselves or with the Springfield musket.

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He also knew that the so-called Enfield rifle was the best foreign musket we could purchase abroad. He also undoubtedly knew that all English-made arms had barrels proved in government proving-houses; and he probably knew that all the Enfield guns we could buy were made in private establishments, or were what is called hand-made, that is, not exactly alike when measured with guages, but so nearly alike that the difference could not be measured with the eye.

But if factories should become organized to make guns by hand, the Springfield armory would not retain its prestige, and with it would fall the whole system, including official supervision, as one official "proving-house" would be sufficient for proving all the barrels that could be made in the United States, for which duty but one or two West Point officers would be necessary; and if the barrels were so proved, one officer could inspect 500 finished muskets in one day, if guages were not to be applied to each piece.

Had the Ordnance Department made it known, at the beginning of the war, that muskets of the Enfield pattern, manufactured in this country, from barrels made and proved in England would be accepted, hundreds of factories would have been established in this country, for the purpose of furnishing guns of that kind to the Government. And if the Ordnance Department established a "proving-house" in New York City, where barrels could have been proved and stamped, the purchase of barrels, even from foreign countries, would have ceased, and the arms would have been furnished to the Government in the same time they were furnished when brought here finished; for most of the gun factories, from which we did receive arms of the Enfield pattern, were established in England to meet the demand *after the arms were contracted for here by Gen. Ripley*, and this was the reason importers invariably asked for contracts in advance.

The Enfield rifles we have purchased since the war began *are not Enfield.* The Enfield factory *is a Government factory*, like our Springfield factory, *and no arms are supplied from it, except for the use of the British Government.*

In England there is a law making it a penal offense to offer

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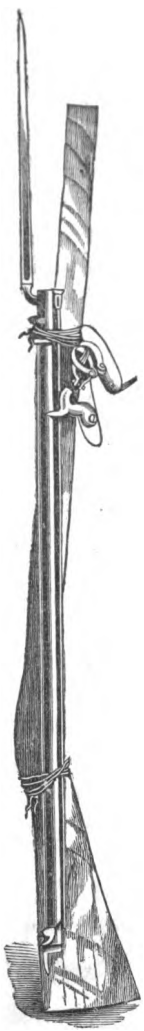
a gun of any kind for sale, the barrel of which was not proved and stamped officially. So well was this known to our Ordnance officers, that when Enfields were offered for inspection, they were simply examined to see that they were of uniform appearance, that all the extra parts were furnished, and that the lock and spring were sufficient; after such an examination they were passed. If *we* had a "proving-house," we might have had uniform calibres to all the arms in the hands of our soldiers. We could have uniform length of barrel, we could have had all bayonets interchange, and also all cones (nipples), barrels, ramrods, stocks, locks, and lock-hammers or cocks, and this interchange is all, and *even more* than is necessary for practical use.



Had Mr. Blunt been informed that Enfield pattern guns made in this country, using only foreign barrels, would be received, I can say, from my acquaintance with him, and from my present knowledge of his system of making guns, that I believe he would have produced 500 Enfield pattern muskets, as good as any purchased abroad, at the end of the first month; and thereafter, each month, an equal number, after receiving the order; and that in four months he would have been prepared, with the necessary machinery, to furnish the barrels of his own manufacture, and offer from four to five thousand guns a month, and it would not have been necessary to invest more than $25,000 capital for a business of that extent. And, further, in addition to what Mr. Blunt could do, factories would have been established in great number, for the manufacture of parts, such as barrels, bayonets, etc.

In England, a proprietor having a warehouse, and having in view to sell to the United States, will make a purchase of barrels and stocks, in the rough; also ramrods, bayonets, and parts of

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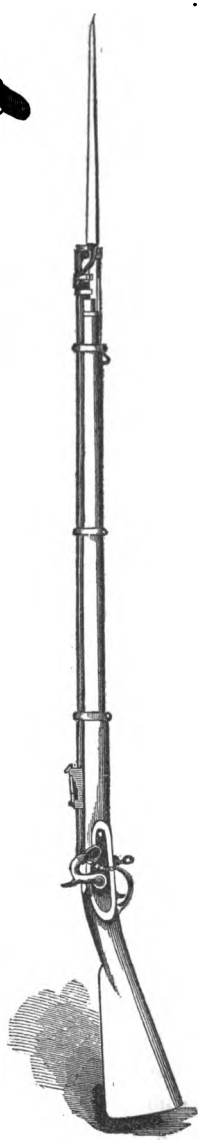
muskets. These are tied up in bundles, and

six, more or less, given to stockers, who take them to their homes, and in a few days they return this lot, stocked; they are paid for their work, and take another lot. Then the stocked barrels are given to the finishers, in the same manner, who take them to their homes and return them when finished. The guns are packed in the cases, and are ready for shipment or sale to a broker, who sells them to the United States Government.



When there is a great demand for guns, various tradesmen will engage upon their manufacture. A wood carver, for instance, will take a lot of guns, and in a week, by the aid of a sample gun, will become an expert stocker. So also will brass finishers, model-makers, blacksmiths, machinists, locksmiths, and mechanics learn to be finishers; and this is the system attempted to be inaugurated in this country by Mr. Blunt.

It was such guns as these that struck the Ordnance Department with consternation. Such a practical innovation could never be submitted to. It was just such a system that Gen. Ripley feared, when in all his offers of contracts he *inserted the Springfield clause*. He insisted upon this so stoutly in all his reports and correspondences, that the Secretary of War was defeated in his efforts to have guns of home manufacture, and Messrs. Holt and Owen, Commissioners for examining contracts for the purchase of arms, were prevented from discovering the real difficulty. All the technical knowledge

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they had upon the subject, being furnished to them by the able ordnance officer detailed to assist them in their difficult and novel duties.

The policy that only obtains propositions for the manufacture of arms, from those who do not know the difficulties attending the production, must always result in disappointment to the government and ruin to the mechanics. It is, however, the essence of the practice in the circumlocution office, and establishes "*the how not to do it*" principle on a firm basis.

From the first day of June, 1862, to February 1, 1863, the time that the delivery of 265,762 Springfield Muskets matured, but a few thousand of these were delivered. To what cause will these failures be attributed? Not to any fault of the system, but unjustly to want of skill, capital, or energy in the contractors. But to attribute it to *that* cause, will be a great and scandalous injustice to a large number of the contractors. When I read in the correspondence that has been published relating to contracts, the request of a contractor for permission to enter the Springfield Armory, to see the process, it occurs to me, at once, that that man is about to enter upon a work, the details or magnitude of which he does not understand, and my sympathies are strongly excited for him, as they would be if I saw a fellow-creature approaching a precipice. Gen. Ripley stands by and knows its depth, but he does not warn him, or if he does, he calls the danger by a name that incites him to advance. For difficulties do but incite mechanics to greater exertions. They are not so mad, however, as to enter with their eyes open upon certain destruction. Mr. Blunt wished to supply the Government with arms, manufactured in the same manner as the Enfield, and to have the same appearance. The time in which he might have produced the arms, was all expended in correspondence. He has manufactured many thousands of muskets, and his establishment has been long capable of manufacturing over a 1000 per week. Yet he has not been permitted to furnish to the Government a single musket. I have seen the muskets of his manufacture, and I pronounce them equal to any European gun brought to this country, and sold to the Government; and far superior to many, as Mr.

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Blunt modestly states in his letter to me. Those who read my pamphlet on "Small Arms," will more fully understand the wrongs suffered by Mr. Blunt at the hands of the Circumlocution Office under the control of Gen. James W. Ripley.

UNIFORMITY OF CALIBRES.

The importance and necessity for the immediate establishment of a uniform system of calibres for all government ordnance, designed for service in the Army and Navy of the United States, can hardly be overstated. Most of the inefficiency, delay, and embarrassment that has been experienced and has formed so marked a feature in the various campaigns of our Armies in the field, and our mixed Army and Navy expeditions, may be traced, and is justly attributable, to the lack of a common and uniform system of calibres. In fact we have had no system of field artillery, even for the Army, and the Navy system of boat howitzers, though much more complete, varies in the calibre of its guns and the character of its ammunition from the light artillery of the Army. In regard to larger guns the Army established certain calibres, and Admiral Dahlgren fixed certain other calibres for the Navy, varying but little from those used in the Army, sufficient, however, to require entirely different ammunition, and thus to perpetuate a difference which was only calculated to give prominence to the Ordnance Officer's name marked on the guns. A difference, however, costing millions to the Government. One of the first steps to be taken by the Army and Navy Departments to secure uniformity of calibre, and which should be taken at once, is to jointly decide upon such a system as will give the greatest efficiency, a perfect uniformity, and the fewest allowable calibres for all ordnance and small arms hereafter to be constructed for the Government, and to have this system confirmed by act of Congress at the earliest practicable moment, so as to

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hereafter make it impossible for any Bureau or Ordnance Officer to introduce any changes except upon the most careful and matured consideration by Congress, acting upon evidence. This course will save millions to the treasury, and quadruple the efficiency of our Army and Navy. Calibres for cannon should range from three inches to twenty inches, and should always be without fractional parts of inches, with the single exception of the light rifled field gun, which should have a calibre of 2 6-10 inches, in order to secure the greatest number of rounds of ammunition, and the greatest mobility, efficiency, accuracy, and range for all varieties of field service for which light artillery is adapted, and at the same time to require the least motive power for effective transportation on the march, with the greatest facility for rapid movement on the field of battle.

N. W.

27

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